AD-A083 386 BAKER (MICHAEL) JR INC BEAVER PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. CANONSBURG DAM NUMBER 2 (JOHNS--ETC(U)
FEB 80 J A DZIUBEK DACW31-80-C-0025

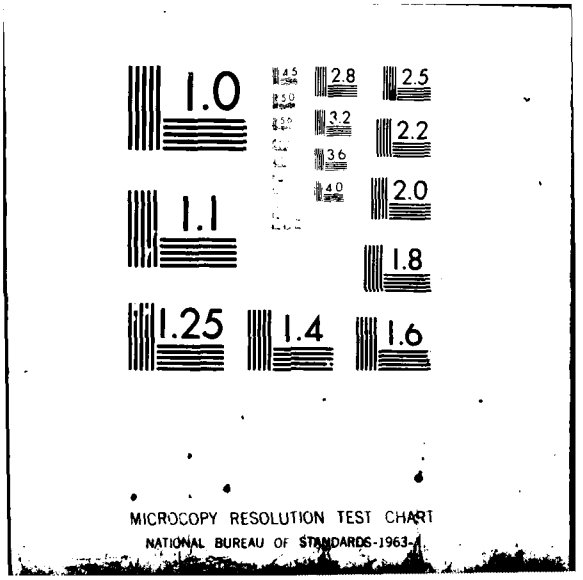
UNCLASSIFIED NL

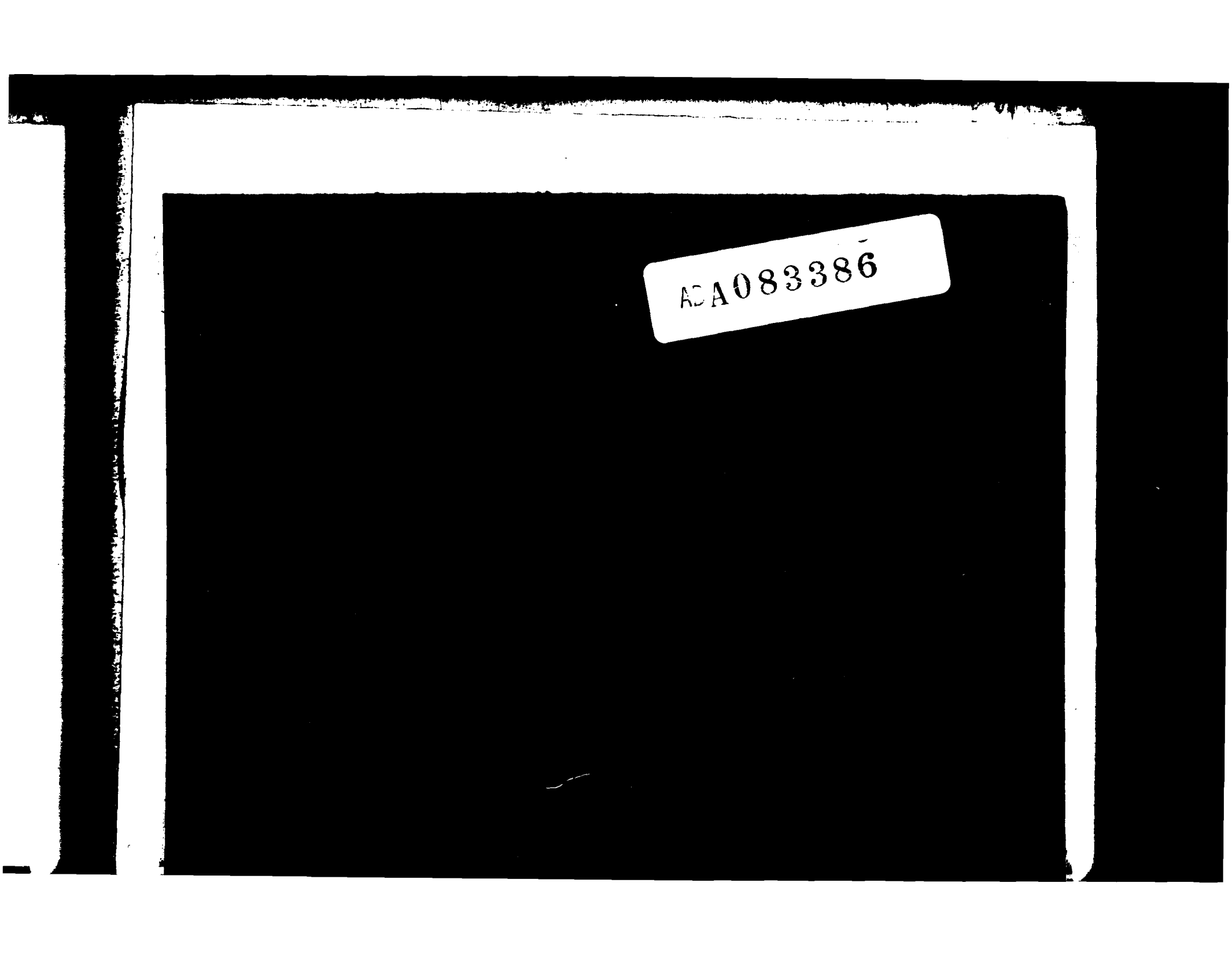
1 OF 2
AD
A083 386








1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



~~OHIO RIVER BASIN~~

CANONSBURG DAM No. 2 (JOHNSONS RUN DAM)
~~WASHINGTON COUNTY, COMMONWEALTH OF PENNSYLVANIA~~
NDI Number PA 00506
PennDER Number 63-41

Ohio River Basin,
Johnsons Run, Washington County,
Pennsylvania.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by: MICHAEL BAKER, JR., INC.
Consulting Engineers
4301 Dutch Ridge Road
Beaver, Pennsylvania 15009

DACW31-80-C-0025

PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Canonsburg Dam No. 2 (Johnsons Run Dam)
Washington County, Pennsylvania
NDI No. PA 00506, PennDER No. 63-41
Inspected 4 December 1979

ASSESSMENT OF GENERAL CONDITIONS

Canonsburg Dam No. 2 is classified as a "High" hazard - "Intermediate" size dam. The dam and reservoir, owned by the Western Pennsylvania Water Company, are used for water supply.

Detailed hydraulic/hydrologic evaluations performed by Burgess and Niple, Limited, and supplemented by Michael Baker, Jr., Inc., in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway will not pass the Probable Maximum Flood (PMF) without overtopping the dam. The analysis indicated that the spillway will pass 45 percent of the required PMF before overtopping will occur. As a result of this analysis and other analyses noted in Section 5, the spillway is considered "inadequate" but not "seriously inadequate." The owner should immediately initiate an engineering study to develop recommendations to provide the necessary spillway capacity.

Because of a landslide on the downstream face and tension cracks and sloughing on the upstream face, the dam was considered to be in need of emergency attention. The landslide on the downstream face had occurred in May 1979 and the owner had initiated an engineering study into the necessary corrective measures. At the time of inspection, the pool was drawn down and construction modifications consisting of flattening the downstream slope and providing a drainage system had commenced. However, signs of instability of the upstream slope had only recently developed (November 1979) prior to the visual inspection on 4 December 1979. Because of these conditions the dam is considered to be in poor overall condition and is classified as being in an "Unsafe" - "Non-Emergency" condition.

On 6 February 1980 a brief review of the dam was performed. At this time it appeared that most of the construction work of flattening the downstream slope had been completed. In addition, the berm on the upstream face had been enlarged to help stabilize the upstream slope. It should be noted that the time frame of this report is written to state the condition of the dam at the time of the visual inspection. This

additional information from the field review was added to show that the owner has taken appropriate measures to correct certain deficiencies at the dam and to reduce the potentially unsafe condition of the dam.

The Western Pennsylvania Water Company has retained the services of a qualified professional engineer experienced in the design and construction of earth dams to make a detailed engineering investigation of Canonsburg Dam No. 2. This investigation resulted in detailed recommendations for remedial work and the initiation of remedial embankment construction. Additional items of investigation and repair should include items 1 through 3 below.

1) Detailed investigation of the structural stability of the dam. Information concerning the downstream slope has been obtained and recommendations implemented. The additional investigation should focus on providing recommendations concerning the upstream slope.

2) Development of recommendations for providing the necessary additional spillway capacity.

3) The condition of the existing outlet pipes and valves is questioned due to the downstream slide. The outlet pipes and valves should be evaluated by the owner's engineer and their performance should be monitored.

Additional items of maintenance necessary for the dam which should be completed as soon as practicable include:

1) Fill the low areas of the embankment on both the right and left side of the spillway structure.

2) Repair the spalled concrete of the spillway structure at the entrance to the spillway, the joints of the chute channel walls, and the end sill of the chute channel.

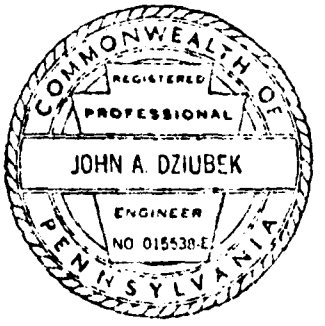
In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system. This can be done in conjunction with Speers Run Dam.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records be developed and implemented.



Submitted by:

MICHAEL BAKER, JR., INC.

John A. Dziubek, P.E.
Engineering Manager-Geotechnical

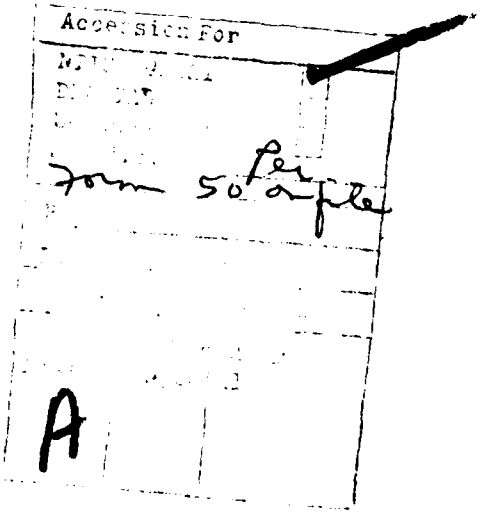
Date: 21 February 1980

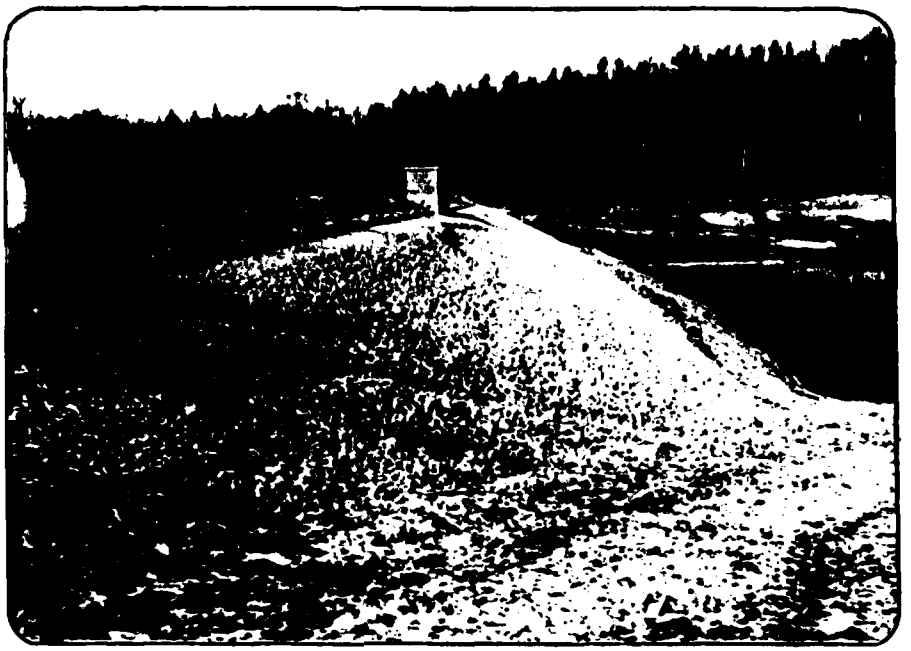
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 19 MARCH 1980





View of Upstream Slope from Left Abutment

View of Crest and Downstream Slope of Dam

TABLE OF CONTENTS

APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

CANONSBURG DAM No. 2 (JOHNSONS RUN DAM)
NDI No. PA 00506, PennDER No. 63-41

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Canonsburg Dam No. 2 (also known as Johnsons Run Dam) consists of an earthfill embankment 36 feet high and 630 feet long. The dam and reservoir, owned and operated by the Western Pennsylvania Water Company, are used for water supply. The embankment is 12 feet wide at the crest, the downstream slope (existing) is 2H:1V (Horizontal to Vertical), and the upstream slope is slightly steeper than 3H:1V with an 8 foot wide berm at Elevation 1008.0 feet. The upstream slope is protected by riprap from 4 feet below the crest to the toe of the slope. The downstream face and crest were protected with a good cover of grass. (Note: Recent construction changes in the downstream slope have stripped the topsoil and cover. The slope is to be flattened to 2.5H:1V.) A clay puddle cut-off trench was constructed below the dam along the same line as the upstream edge of the embankment crest. The minimum design width was 6 feet; however, a 1931 progress report noted that a power shovel was excavating the cut-off trench wider than the proposed design width. A partial grout curtain is shown on an original design drawing (see Plate 5); however, it is uncertain whether the grout curtain was ever constructed.

The spillway consists of an ogee weir located at the right abutment of the dam. The crest length is 35 feet and the spillway crest is 4.5 feet

below the crest of the embankment. The spillway is shown as being constructed on in-situ material of the right abutment and having a cut-off wall extending into "watertight material." The discharge channel is of reinforced concrete construction that curves slightly back toward the center of the dam just downstream from the ogee section. The chute narrows near the bottom to a width of 10 feet with 4.83 feet high vertical walls. At the very bottom the channel then flares out and is 21 feet wide with a 1 foot high weir forming an end sill.

The outlet works include an upper level intake 17 feet below the crest consisting of a 12 inch cast-iron pipe, and a lower level intake 33 feet below the crest of the dam consisting of a 16 inch cast-iron pipe. Both intake pipes are controlled by valves housed in a valve building located on the crest of the dam. Immediately downstream from the riser, both pipes are shown entering a 16 inch cast-iron outlet pipe. Both intake pipes have concrete anti-seep collars and are enclosed in a minimum of 8 inches of reinforced concrete.

b. Location - Canonsburg Dam No. 2, located across Johnsons Run, is 1.7 miles upstream from the confluence of Johnsons Run and Little Chartiers Creek. The structure is located in North Strabane and Peters Township, Washington County, Pennsylvania. The coordinates of the dam are N 40° 15.4' and W 80° 6.9'.

c. Size Classification - The maximum height of the dam is 36 feet and the reservoir volume at the top of the dam is 1040 acre-feet. The dam is therefore in the "Intermediate" size category.

d. Hazard Classification - Speers Run Dam and Reservoir (NDI No. PA 00505) are located downstream from Canonsburg Dam No. 2. In the event of a failure of Canonsburg Dam No. 2, it is likely that Speers Run Dam will be overtopped and will subsequently fail. Speers Run Dam and Reservoir have been assigned a "High" hazard classification by GAI Consultants, Inc., Phase I Inspection Report, dated July 1978. Therefore, Canonsburg Dam No. 2 is also considered in the "High" hazard category.

e. Ownership - The dam is owned by the Western Pennsylvania Water Company, Washington District. Mr. Frank A. Kohler, Jr., 62 East Wheeling Street, Washington, Pennsylvania 15301 is the manager of this district.

f. Purpose of Dam - The dam is used for public water supply.

g. Design and Construction History - The dam was designed by D. C. Morrow, Engineer for the Citizens Water Company of Washington, Pennsylvania. Construction of the dam started on 21 July 1931 and was completed in June 1932.

h. Normal Operational Procedures - Typically, the reservoir is maintained at the normal pool level; however, because of the slide on the downstream slope, the reservoir has been drawndown. The reservoir level is recorded weekly and the crest is walked during that site visit. Water from the reservoir is released, via the outlet works and water supply line, as necessary to Speers Run Reservoir downstream. This system has recently been used to drawdown the reservoir.

1.3 PERTINENT DATA

a. Drainage Area (square miles) -	1.54
b. Discharge at Dam Site (c.f.s.) -	
Maximum Flood -	Unknown
Spillway Capacity (at Pool El. 1035.0 ft. from Burgess and Niple, Limited "Synopsis of Flood Routing Results," 26 January 1979) -	890
c. Elevation[1] (feet above Mean Sea Level [M.S.L.]) -	
Design Top of Dam[2] -	1035.8

[1]Referenced to Spillway Crest Elevation 1030.8 feet used by Burgess and Niple, Limited. The original design drawings show the crest Elevation is 1024.5 feet. The conversion of the elevations on the original design drawings to Burgess and Niple, Limited elevations is 6.3 feet.

[2]Original design top of dam (1931) converted to elevations set by Burgess and Niple, Limited (1979). Note on Plates 8 through 12, Appendix E, that proposed modifications include raising the top of the embankment to a minimum Elevation of 1035.5 feet.

Actual Top of Dam[3] (as of 4 December 1979 field inspection) - Varies from 1033.0 (low spot on right side of spillway) to 1035.7	
Maximum Design Pool -	Unknown
Spillway Crest[4] -	1030.8
Upper Level Intake -	1018.3
Lower Level Intake -	1001.8
Streambed at Centerline of Dam -	999.0±
Maximum Tailwater of Record -	Unknown

d. Reservoir (feet) -

Length of Maximum Pool -	4250
Length of Normal Pool -	3500

e. Storage (acre-feet) -

Top of Dam (El. 1035.0 ft.) -	1040
Spillway Crest (El. 1030.8 ft.) -	850

f. Reservoir Surface (acres) -

Maximum Pool (El. 1035.0 ft.) -	59.4
Spillway Crest (El. 1030.8 ft.) -	48.4

g. Dam -

Type -	Earthfill
Length (feet) -	630
Maximum Height (feet) -	36
Top Width (feet) -	12
Slopes - Upstream -	3H:1V
Downstream -	2H:1V
(Note: Proposed revised downstream slope is 2.5H:1V)	
Zoning -	None
Impervious Core - Homogeneous embankment with a high percentage of clay material.	

---

[3]The low spot on the right side of the spillway was repaired and raised to Elevation 1035.0 feet as of 6 February 1980. (See page A-14.)

[4]Referenced to Spillway Crest Elevation 1030.8 feet used by Burgess and Niple, Limited. The original design drawings show the crest Elevation is 1024.5 feet. The conversion of the elevations on the original design drawings to Burgess and Niple, Limited elevations is 6.3 feet.

[5]Storage vs. elevation rating curve used for this report was supplied by Burgess & Niple, Inc.

Cut-off - A clay puddle cut-off trench with a minimum 6 foot width at the base was constructed beneath the embankment along the same line as the upstream edge of the embankment crest.

Grout Curtain - A partial grout curtain beneath the right end of the dam is shown on Plate 5. However on Plate 6, this grout curtain is not shown. In addition, the specifications reviewed do not mention the grout curtain.

Drains - None

(Note: Chimney drains, embankment drainage blankets, and toe drains are proposed as part of the downstream slope modifications. See Plates 8-12 for the proposed locations and details.)

h. Diversion and Regulating Tunnel - None

i. Spillway -

Type - Concrete ogee weir with chute channel

Crest Length Perpendicular to Flow (feet) - 35

Crest Elevation (feet M.S.L.) - 1030.80

Gates - None

Upstream Channel - The spillway is located at the right abutment of the dam. The reservoir bottom formed by the junction of the right abutment and dam serves as the earth-lined upstream channel. The channel is 2 feet deep in front of the crest of the spillway.

Downstream Channel - Reinforced concrete chute channel sloping from 8 percent near the crest to 21 percent near the discharge end.

j. Outlet Works - Two intakes (El. 1001.8 ft. and El. 1018.3 ft.) are used for the water supply system. The upper intake is a screened chamber with a 12 inch cast-iron pipe outlet. The lower intake is a screened chamber with a 16 inch cast-iron pipe outlet. Both outlets are controlled by 2 valves each (in series) at the outlet works tower. According to the design plans, just downstream from the tower the two pipes come together at a "wye" and a 16 inch cast-iron pipe then carries the flow to the downstream toe. This 16 inch cast-iron pipe was later revised to discharge directly into the Speers Run Reservoir (Canonsburg Reservoir

No. 1). The 16 inch cast-iron pipe which passes through the downstream embankment branches into the 16 inch pipe which discharges into Speers Run Reservoir and a 12 inch cast-iron pipe which discharges into the outlet channel at the toe of Canonsburg Dam No. 2. Both branches of the pipe (the 16 inch and 12 inch) have control valves downstream of the second "wye" at the downstream toe of the dam. In addition, a meter pit for sampling the water was installed at the toe of slope. Two 1 inch copper pipes with control valves exit into the pit for collection of water samples. All of the pipes in the dam have been encased in concrete and 3 anti-seep collars are constructed around the upstream half of the system.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The information reviewed consisted of Pennsylvania Department of Environmental Resources' (PennDER) File No. 63-41 and information supplied by Burgess and Niple, Limited. PennDER's file included the following information:

1) Specifications and contract document for the construction of an earthen dam.

2) The permit application.

3) The permit granted to the Citizens Water Company of Washington from the Commonwealth of Pennsylvania, Water and Power Resources Board.

4) Inspection and progress reports made during the construction of the present structure.

5) The permit application to construct a roadway embankment structure across the reservoir upstream from the dam.

6) The permit granted to the Citizens Water Company of Washington from the Commonwealth of Pennsylvania, Water and Power Resources Board, granting permission for the construction of the fore mentioned structure.

7) Post-construction reports made by engineers of the Water and Power Resources Board. The latest inspection report contained in this file was dated 5 September 1961.

The original design drawings are reproduced and presented as Plates 3, 4, 5, and 6.

Information supplied by Burgess and Niple, Limited included the following:

1) Unit hydrographs.

2) Synopsis of flood routing results, text, and attachments.

3) Synopsis of flood routing results - supplement.

4) Letter from PennDER, dated 10 May 1979.

5) HEC-1 Dam computer output.

6) Soil boring logs and test results from recent investigation.

7) Canonsburg Dam No. 2 embankment improvement construction drawings (these drawings have been included as Plates 7-12 of this report).

2.2 CONSTRUCTION

During the construction, a resident engineer was provided by the Citizens Water Company of Washington. In addition, personnel from the Water and Power Resources Board made several inspections of the dam while construction was in progress.

No "as built" drawings were available for review. However, in the PennDER file 63-41 there were reports from personnel of the Power Resources Board that presented information concerning modifications made during the construction of the puddled clay cut-off trench.

1) The cut-off trench had been refilled from the gate tower to the left hillside and the embankment placed to a maximum depth of approximately 12 feet. The material used in the embankment contains a higher percentage of clay than desirable but was placed in 6 inch layers well rolled. (From Progress Report dated 29 September 1931.) (Note: This is the area that is currently unstable.)

2) The gate house was partially constructed at the location shown on the plan but because of over excavation, it was intended to lay the pipes on fill. As the depth of fill (where the pipes join the gate house) is approximately 15 feet, the Citizens Water Company was advised that the concrete supports should be carried to a firm foundation. It was agreed that this would be done for the full length of the pipe. (From Progress Report dated 29 September 1931.)

3) The cut-off trench was open from the creek channel to the right end of the dam; it had been dug wider than called for by use of a power shovel. A narrow trench for a cut-off wall had been dug in the bottom of the wide

trench, except for a short section where the bottom appeared to be exceptionally solid rock. (From Progress Report dated 2 November 1931.)

2.3 OPERATION

The Western Pennsylvania Water Company, Washington District, is responsible for the maintenance and operation of the dam. Records of rainfall and reservoir level are kept on file at the filtration plant near the dam.

2.4 EVALUATION

a. Availability - The drawings available from the PennDER's files were not listed as "as built." However, from review of the periodic construction reports, the drawings appear to be accurate.

b. Adequacy - The information available is adequate for a Phase I Inspection.

c. Validity - There is no indication at the present time to doubt the validity of the available engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The visual inspection was performed on 4 December 1979 and no unusual weather conditions were present. The dam and its appurtenant structures were found to be in poor overall condition including instability of the embankment. The pool was drawn down at the time of inspection because of a slide on the downstream face of the dam. Construction operations consisting of stripping the downstream area and the upper one foot of soil (topsoil for the grass) on the downstream slope had commenced the day before the inspection and were continuing at the time of inspection. Noteworthy deficiencies observed during the visual inspection are described below. The complete visual inspection check list, field sketch, top of dam profile, and typical cross-section are presented in Appendix A.

b. Dam - Several areas of instability of the embankment were observed during the visual inspection. From Station 7+22 to Station 8+50 on the downstream face a slide has occurred. (Note: The stationing used during the visual inspection is shown on the field sketch in Appendix A.) The maximum movement along the slip was approximately 10 feet resulting in a partial reworking of the material. However, the majority of the material in the slide moved en masse. According to the owner's personnel, the slide occurred after an unusually heavy rainstorm. Investigation into the slide and overall condition of the embankment have been performed by consulting engineers for the owner. One piezometer was installed from the crest of the embankment at approximate Station 8+00. The piezometer reading at the time of inspection was only 1.5 feet of water or approximately 51.5 feet below the crest of the dam. The embankment material which could be examined was primarily a low plasticity clay (CL) material with some silt.

On the upstream slope from Station 7+50 to Station 9+15, a slide scarp had recently developed (within the last half of the month of November 1979). This scarp, at the time of inspection, had a maximum downward movement of approximately 1.5 feet. The upstream slope was bulging at the level of the berm on the upstream face. In addition, localized sloughing of the face had occurred below the level

of the berm in the approximate center of the slide scarp (Station 8+50). It is estimated that this slide has developed because of rapid drawdown of the reservoir; however, the owner was planning to have an investigation into the possibility of mine subsidence.

At the time of inspection, construction of the modifications to the downstream slope had started. Items completed included 1) clearing and grubbing of the area approximately 50 feet beyond the existing toe of the embankment, 2) stripping of the topsoil for the entire toe area along the left side of the embankment, and 3) stripping of the topsoil on the downstream face of the embankment. These modifications were being performed by Ram Construction Company.

Low areas were observed immediately to the left and right of the spillway structure. The area to the right is approximately 25 feet in length (along the crestline of the embankment) and 2 feet low. The area to the left is in front of and around the cut-off wall transition buttress at the junction of the embankment and the spillway structure.

Other observations during the visual inspection include:

1) The edge of a piece of plywood sheeting was seen partially protruding from the embankment on the upstream face (see field sketch). The reason why this sheeting is there is not known except that poor construction practices may possibly have been used in constructing the embankment.

2) Departures from the design plans in the construction of the upstream slope include a berm, a flatter slope, and not installing the riprap to the crest of the dam.

c. Appurtenant Structures - A few minor deficiencies of the spillway structure include:

1) At the entrance to the spillway on both training walls, severe spalling of the concrete at the normal pool level has occurred.

2) The vertical construction joints of the chute channel walls are spalled in a few places and generally the joints are in need of minor repair.

3) The end sill of the chute channel is spalled and should be repaired.

The condition of the outlet works in the tower was not examined because the inspection plate was bolted closed. However, a later phone conversation with one of the owners representative disclosed that the condition of the outlet works was recently examined during the construction modifications and one of the valves repaired. The condition of the upper level intake was good and no problems were observed. The lower level intake and outlet structure were submerged and were not observed.

d. Reservoir Area - Most of the siltation of the reservoir has occurred in the area upstream of the roadway embankment which crosses the reservoir. It could be observed that some of the borrow from the dam was obtained from both the right (approximately 500 feet upstream) and left (almost immediately upstream) valley slopes in the reservoir.

e. Downstream Channel - The downstream channel is a naturally occurring streambed that is partially forested with trees and low bushes. Located approximately 1400 feet downstream from the dam is Water Dam Road. The confluence of Johnsons Run and Speers Run Creek is another 100 feet downstream from the road. Speers Run Dam (NDI No. PA 00505, also known as Canonsburg Dam No. 1) is 1.25 miles downstream from Canonsburg Dam No.2. Located 3.25 miles downstream from Canonsburg Dam No. 2 is Alcoa Dam (NDI No. PA 00493) on Little Chartiers Creek. Three homes which may suffer economic damage in the event of a dam failure are located between the dam and Water Dam Road. Speers Run Dam is assigned a "High" hazard category (see GAI Consultants, Inc., Phase I Inspection Report, dated July 1978). Therefore, additional damage centers are located downstream from Speers Run Dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal written procedures in the event of a impending failure of the dam. The condition of the dam is checked frequently by personnel from the water company.

Formal emergency procedures for Speers Run Dam have been developed. It is recommended that these emergency procedures be extended to include emergency operation and surveillance of Canonsburg Dam No. 2.

4.2 MAINTENANCE OF DAM

The Western Pennsylvania Water Company is responsible for maintenance of the dam. Although a slide has occurred on the downstream face and a slide scarp on the upstream face, it appears that the remainder of the dam has received reasonable care. However, it is good practice to have formal maintenance and inspection schedules and it is therefore recommended that these be developed and implemented.

4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance of the operating facilities has been performed on an as needed basis. It is recommended that formal operation and preventive maintenance schedules be developed and implemented.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

Formal emergency procedures for Speers Run Dam should be adapted to include Canonsburg Dam No. 2.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design calculations are available for the original design of Canonsburg Dam No. 2.

b. Experience Data - Weekly reservoir records are kept by the West Penn Water Company and are available at the Canonsburg filtration plant.

c. Visual Observations - There is a low spot on the right abutment which is approximately 2 feet below the average crest elevation. This area should be restored to the design crest level (Elevation 1035.0 feet) to prevent overtopping of the dam in the area.

d. Overtopping Potential - Canonsburg Dam No. 2 is an "Intermediate" size - "High" hazard dam requiring evaluation for a spillway design flood (SDF) equal to the Probable Maximum Flood (PMF).

Hydrologic and hydraulic analysis of Canonsburg Dam No. 2 has been performed by Burgess and Niple, Limited in 1979 as part of an investigation to determine the adequacy of the designs of Canonsburg Dam No. 2 and Dam No. 1. As their analysis appears to be reasonable, the results of their study were utilized in this report.

A brief description of the analysis performed by Burgess and Niple, Limited is as follows (additional information is contained in Appendix D). The run-off hydrographs for the watershed were developed by adapting unit hydrographs obtained from a study conducted by the Pittsburgh District Corps of Engineers for several locations in the Chartiers Creek basin. Discharge ratings (including tailwater effects) were calculated using the HEC-2 program. The Flood Hydrograph Package, HEC-1, was then employed to route run-off hydrographs through the basin for both the 1/2 Probable Maximum Flood (1/2 PMF) and PMF events.

The results of this analysis show that the spillway of Canonsburg Dam No. 2 is capable of passing approximately 45 percent of the PMF without overtopping. During the 1/2 PMF, the dam is overtopped for 2.5

hours by a maximum depth of 0.16 foot. The PMF results in overtopping for 10 hours by a maximum depth of 0.95 foot.

e. Spillway Adequacy - The dam, as outlined in the above analysis, would be overtopped by the PMF and 1/2 PMF. The first criteria for spillway adequacy determination requires an estimate of whether the dam will fail during the 1/2 PMF. The following conditions, as well as the overall state of the dam, were used as the limiting criteria which are likely to cause failure of this dam.

1) Depth of overtopping of 1.0 foot or greater.

2) Duration of overtopping in excess of 2 hours.

The overtopping analysis of this dam yielded the following values for the 1/2 PMF.

1) Depth of overtopping equal to 0.16 foot.

2) Duration of overtopping equal to 2.5 hours.

Therefore, the spillway is rated as being "inadequate" rather than "seriously inadequate."

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - Visual observations of slope landsliding, tension cracks, and sloughing are presented in Section 3 and Appendix A. It is obvious that structural stability under the observed conditions is marginal. The owner has retained a consulting engineer to perform evaluations of the downstream slope instability and provide recommendations for corrective action. Those recommendations are currently being implemented by flattening of the downstream slope and the incorporation of a drainage system. It is recommended that further investigation be performed to evaluate the stability of the upstream slope and provide qualified recommendations for corrective measures.

b. Design and Construction Data - Calculations of structural stability for the original design of the dam were not available for review. Calculations of embankment stability for the downstream slope modifications were requested, but had not arrived by the time of preparation of this report. According to information from a construction progress report during original construction of the dam, "the material used for the embankment contained a higher percentage of clay than desirable."

c. Operating Records - Recent drawdowns of the reservoir have probably contributed or are the reason for instability of the upstream slope. (Note: At the time of inspection the owner was going to initiate an investigation of the possibility of mine subsidence affecting the dam.)

d. Post-Construction Changes - The post-construction changes identified and those changes proposed will probably improve the structural stability of the dam.

e. Seismic Stability - The dam is located in Seismic Zone 1 on the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is an area of minor seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if they have adequate stability under static

loading conditions. There will be no need for further consideration of seismic stability if the recommended engineering investigation shows the dam (with remedial measures, as necessary) has adequate static stability.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - Visual observations performed in December 1979 indicated the dam to be in an unsafe condition. Several observed features of landsliding and tension cracks in the embankment indicate that a thorough evaluation of the structural stability of Canonsburg Dam No. 2 is necessary.

Canonsburg Dam No. 2 is evaluated as a "High" hazard - "Intermediate" size dam and should have a hydraulic capacity sufficient to pass the PMF. As presented in Section 5, the spillway and reservoir were determined to have a capacity of only 45 percent of the PMF without overtopping the dam. Based upon this analysis and other analyses noted in Section 5, the spillway is considered "inadequate" but not "seriously inadequate."

b. Adequacy of Information - The readily available information and the observations made during the field inspections of the dam are considered sufficient for purposes of this Phase I Inspection Report.

c. Urgency - The presence of the landslide on the downstream slope and tension cracks and sloughing on the upstream face indicated that the dam was in need of emergency attention. The reservoir was drawn down prior to the visual inspection performed on 4 December 1979. The landslide on the downstream face occurred in May 1979 and the owner is in the process of performing construction modifications to the downstream slope. The tension crack and instability of the upstream slope has recently developed (in November 1979) and should be thoroughly investigated and corrected.

d. Necessity for Additional Data/Evaluation - The condition of the embankment has indicated the need for a thorough evaluation of the structural stability of the embankment. The owner has retained the services of a qualified professional engineer experienced in the design and construction of earth dams to develop recommendations concerning the embankment stability. Remedial embankment construction was in progress on 6 February 1980. The hydraulic/hydrologic analyses performed for this dam has indicated the need for additional

spillway capacity. Therefore, recommendations for providing the necessary spillway capacity should be developed and implemented.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The Western Pennsylvania Water Company has retained the services of a qualified professional engineer experienced in the design and construction of earth dams to make a detailed engineering investigation of Canonsburg Dam No. 2. This investigation has resulted in detailed recommendations for remedial work and the initiation of remedial embankment construction. Additional items of investigation and repair should include items 1 through 3 below.

1) Detailed investigation of the structural stability of the dam. Information concerning the downstream slope has been obtained and recommendations implemented. The additional investigation should focus on providing recommendations concerning the upstream slope.

2) Development of recommendations for providing the necessary additional spillway capacity.

3) The condition of the existing outlet pipes and valves is questioned due to the downstream slide. The outlet pipes and valves should be evaluated by the owner's engineer and their performance should be monitored.

Additional items of maintenance necessary for the dam which should be completed as soon as practicable include:

1) Fill the low areas of the embankment on both the right and left side of the spillway structure.

2) Repair the spalled concrete of the spillway structure at the entrance to the spillway, the joints of the chute channel walls, and the end sill of the chute channel.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system. This can be done in conjunction with Speers Run Dam.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH, TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION

Check List
Visual Inspection
Phase 1

Name of Dam Canonsburg Dam No. 2 (Johnsons Run Dam) County Washington State PA Coordinates Lat. N 40°15.4' Long. W 80°6.9'

NDI # PA 00506
PennDER # 63-41

Date of Inspection 4 December 1979 Weather Cool, sunny Temperature 35°-40° F.

Pool Elevation at Time of Inspection 1007.9 ft.* M.S.L. Tailwater at Time of Inspection 996.0 ft.* M.S.L.

*All elevations referenced to spillway crest (El. 1030.8 ft. as determined in Burgess and Niple, LTD, survey conducted in 1978; note that original plans dated May 1931 show spillway crest at El. 1024.5 ft.)

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Wayne D. Lasch
Jeff S. Maze

Field Review (6 February 1980)

John A. Dziubek
James G. Ulinski

Owner's Representatives:

Ralph Newman (part-time)
Bill McAdams (part-time)
Walter Cole of Burgess and Niple (part-time)

James G. Ulinski Recorder

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)
NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)

NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

EMBANKMENT

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)
NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	A tension crack was observed on the upstream slope from Station 7 + 50 to Station 9 + 15. (Note: The stationing used is shown on the field sketch.) The vertical separation along the crack varied from a minimum of approximately 6 in. to a maximum of 1.5 ft. The tension crack was located from 6 ft. at the highest point to 9.5 ft. at the ends below the crest of the dam.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	In association with the tension crack on the upstream face, the upstream slope showed a noticeable bulging at the level of the berm on the upstream face. In addition, minor sloughing of the embankment had occurred on the embankment below the berm level. On the downstream slope a slide has occurred. The limits of the slide are approximately from Station 7 + 22 to Station 8 + 50. The high point of the slide is approximately 18 ft. below the crest. Approximately 10 ft. of vertical movement occurred along the slide scarp.	The Western Pennsylvania Water Company has engaged the services of a consulting engineering firm to evaluate and develop recommendations concerning the slides.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The portions of the embankment not affected by the above mentioned slides appeared to be in good condition and no signs of sloughing or erosion was observed. It should be noted that the inspection was performed at about the same time as construction operations (continued next page)	

EMBANKMENT

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)
NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES (con't.)	for modification of the downstream slope were started. At the time of inspection, the downstream toe area of the right half of the embankment had been stripped and construction operations were proceeding to strip the topsoil from the left half of embankment.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical and horizontal alignment of the crest is acceptable except that the majority of the top of the dam should be raised approximately 6 in. to restore it to the same elevation as the top of the spillway structure. A 25 ft. wide area immediately to the right of the spillway is approximately 2 ft. lower than the top of dam.	
RIPRAP FAILURES	The riprap on the upstream face was in place and no problems were observed.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems were observed on the right abutment junction. The junction of the spillway and the embankment has areas of minor erosion. The right side of the spillway is 2 ft. lower than the embankment as noted previously.	The embankment and spillway junction should be restored to original grade lines.

EMBANKMENT

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)
NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	No seepage was observed. The reservoir level was 23 ft. below the crest of the spillway.	
STAFF GAGE AND RECORDER	None	
DRAINS	No drains were originally installed. Downstream slope modifications plans call for the installation of toe drains (entire length) and chimney drains (Station 7 + 22 to Station 8 + 50).	

OUTLET WORKS

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)

NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet conduit was submerged and could not be observed.	
INTAKE STRUCTURE	The lower level intake was submerged and could not be observed. The upper level intake was in good condition (see Photo 7).	
OUTLET STRUCTURE	No outlet structure was observed, the pipe was submerged and could not be observed. There were five valve boxes present at the toe at the time of inspection; however, these were to be relocated during the slope modifications.	(Note: Additional information concerning the valve boxes was obtained on 19 February 1980 and is included in Paragraph 1.3.j. During the field review on 6 February 1980, it was observed that the valve boxes were not relocated but extended above the new 2.5H:1V downstream slope.)
OUTLET CHANNEL	The channel is free flowing and non-obstructed. A small, old bridge is located downstream; however, this bridge is designed such that overtopping will not damage it.	
EMERGENCY GATE	The lower level intake (16 in. C.I.P.) and upper level intake (12 in. C.I.P.) each have two valves in series and all are reportedly operational. (Note: One valve was recently repaired during the slope modification repairs.)	

UNGATED SPILLWAY

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)
NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The concrete weir is in good condition.	
APPROACH CHANNEL	The approach channel is acceptable except that on both sides of the upstream end of spillway training walls at the water (or ice) level the concrete is spalled and deteriorated (see Photo 1).	These areas should be repaired to prevent further deterioration.
DISCHARGE CHANNEL	The discharge channel is in good overall condition; however, the joints and the end sill are slightly deteriorated and in need of repair.	The joints and end sill should be repaired to prevent further deterioration.
BRIDGE AND PIERS	None installed	
DRAINS	The drains on the outside of the spillway walls were not flowing. The drain under the discharge slab was also not flowing.	

GATED SPILLWAY - Not Applicable

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)
NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

INSTRUMENTATION

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)

NDI # PA 00506

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Survey points have recently been established by Burgess and Niple for the slope modification and other repairs. (See Plate 7 of this report for location and description.)	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	One well point was installed during the recent (1979) drilling program. The well point had 1.5 ft. of water, 51.5 ft. below the crest of the dam, on 4 December 1979 (date of inspection). The reservoir level was 23 ft. below the top of dam.	
OTHER	None	

RESERVOIR

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)

NDI # PA 00506

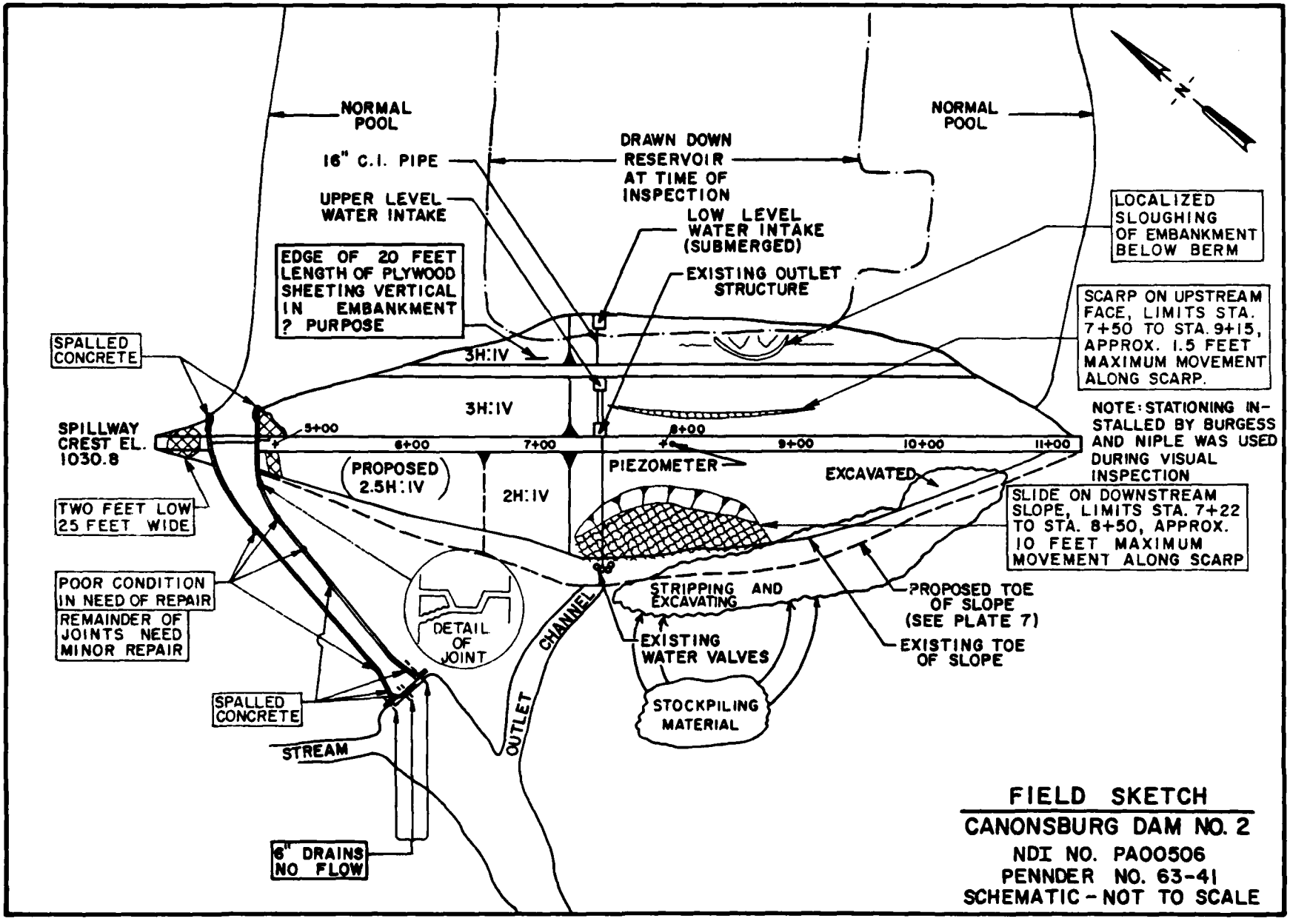
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir slopes are moderately sloping and do not appear to be unstable.	
SEDIMENTATION	The amount of sedimentation is minor compared with the storage of the reservoir.	

DOWNSTREAM CHANNEL

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)

NDI # PA 00506

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The channel from the spillway rejoins the natural streambed approximately 200 ft. downstream. The channel is mildly sloping (approximately 2%) and partially vegetated. No obstructions to flow were present.	
SLOPES	The channel slopes are moderate and forested or grass-lined (in different areas). No problems were observed.	
APPROXIMATE NO. OF HOMES AND POPULATION	Located approximately 1400 ft. downstream from the dam is Water Dam Road. An additional 100 ft. downstream from the road is the confluence of Johnsons Run Creek and Speers Run Creek. Speers Run Creek flows an additional 2100 ft. before entering the reservoir impounded by Speers Run Dam (NDI # PA 00505). Speers Run Dam is located approximately 1.25 mi. downstream from Canonsburg Dam No. 2. Located 3.25 mi. downstream from Canonsburg Dam No. 2 is Alcoa Dam (NDI # PA 00493) on Little Chartiers Creek. Approximately three residential structures are located between Canonsburg Dam No. 2 and the township road. These structures may suffer economic damage in the event of a dam failure. Additional damage and loss of life (see Speers Run Dam Phase 1 Inspection Report, July 1978, by GAI Consultants) may result from failure of Speers Run Dam as a result of the failure of Canonsburg Dam No. 2.	



FIELD SKETCH

CANONSBURG DAM NO. 2

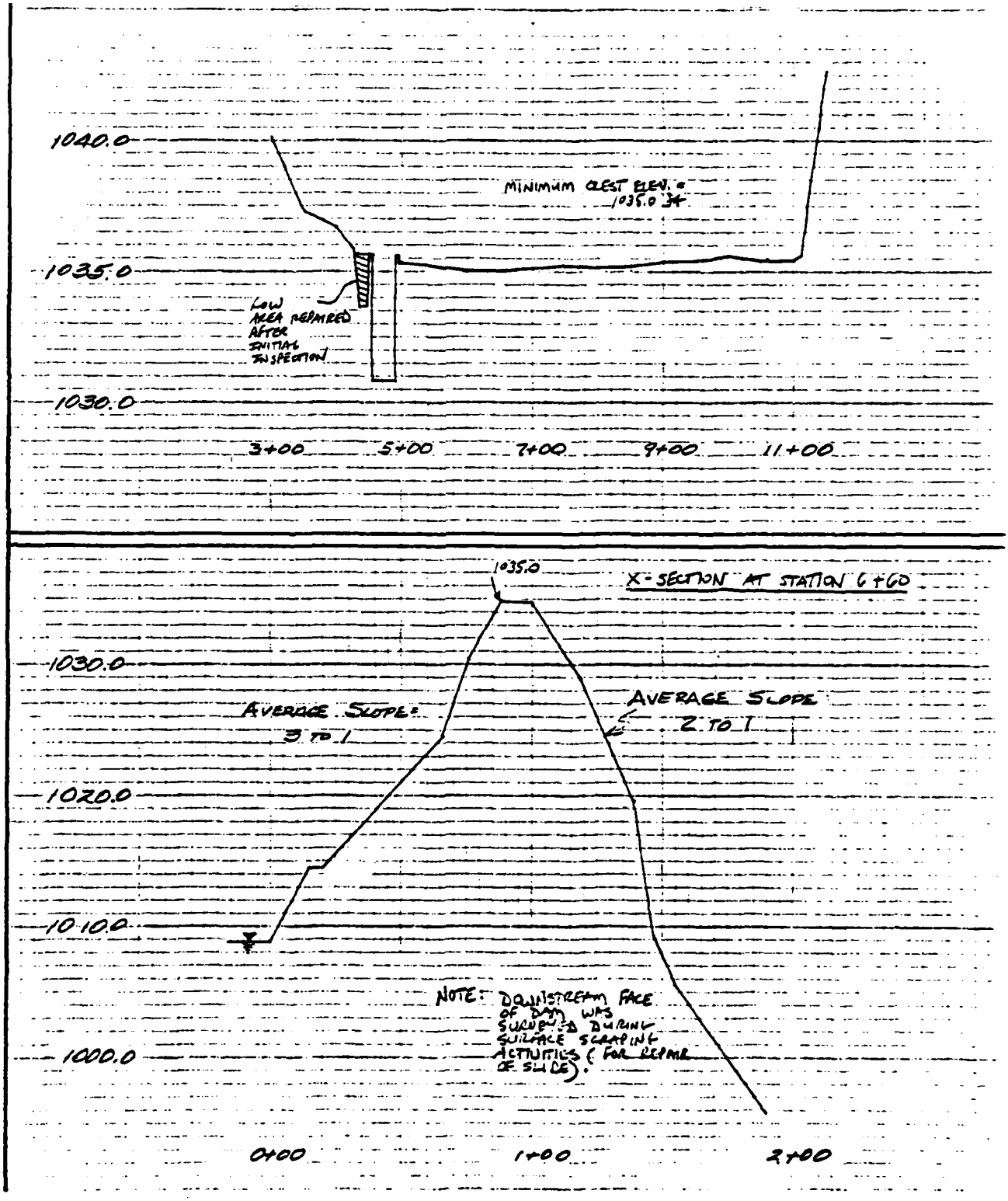
NDI NO. PA00506
PENNDER NO. 63-41
SCHEMATIC - NOT TO SCALE

CANONSBURG DAM No. 2

A-14

TOP OF DAM PROFILE

TYPICAL CROSS-SECTION



APPENDIX B

ENGINEERING DATA CHECK LIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)
NDI # PA 00506

ITEM	REMARKS
PLAN OF DAM	See Plates 3 and 7 of this report.
REGIONAL VICINITY MAP	A USGS 7.5 minute topographic quadrangle, Bridgeville, Pennsylvania, and adjacent quadrangles, Canonsburg, Washington East, and Hackett were used to prepare the Location Plan (Plate 1) of this report.
CONSTRUCTION HISTORY	The dam was designed by the Citizens Water Company of Washington, PA, under the direction of D.C. Morrow, Engineer. The construction of the dam was started on 21 July 1931, and was completed in June 1932. The contractor of the dam is not known.
TYPICAL SECTIONS OF DAM	Original typical sections are shown on Plate 5. Proposed modifications to the downstream slope are shown on Plates 8-12.
HYDROLOGIC/HYDRAULIC DATA	No design data was available.
OUTLETS - PLAN, and DETAILS	See Plate 5 of this report.
- CONSTRAINTS	None
- DISCHARGE RATINGS	None available
RAINFALL/RESERVOIR RECORDS	Rainfall records are kept at the filtration plant for the water supply system. Reservoir records (reservoir level), recorded once a week, are also available at the filtration plant.

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)
NDI # PA 00506

ITEM	REMARKS
DESIGN REPORTS	No design report is available.
GEOLOGY REPORTS	No geology report is available. The regional geology is presented in Appendix F of this report.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	No original design computations are available. Recent hydrology and hydraulics studies have been performed by Burgess and Niple (as applicable these hydrology and hydraulics studies have been included in Appendix D). Dam stability calculations concerning the slope modifications were requested; however, they were not received at the time of preparation of this report.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Plate 4 shows the location and results of the original boring investigation.
POST-CONSTRUCTION SURVEYS OF DAM	The dam has recently been surveyed for the construction modifications. Plans were prepared as a result of that survey (see Plates 7-12); however, the survey cross-sections were taken prior to reservoir drawdown and did not define the small berm on the upstream slope.
BORROW SOURCES	No information is available noting the location of the borrow. From observation of the reservoir area, it appears some borrow may have been obtained from the left side of the reservoir, just upstream from the dam, and also on the right side approximately 500 ft. upstream.

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam) B-3

NDI # PA 00506

ITEM	REMARKS
MONITORING SYSTEMS	One piezometer was recently (1979) installed to investigate the slide on the downstream slope.
MODIFICATIONS	No known modifications were performed to the dam prior to the current repairs to the downstream slope.
HIGH POOL RECORDS	Records are kept at the filtration plant; high pools could be identified by examining these records.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Investigation and corrective measures for the slide on the downstream face was studied in 1979. Also, hydraulic and hydrologic evaluations (1979) were performed in connection with Speers Run Dam (NDI # PA 00505).
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	A downstream slope slide (May 1979) occurred after an 11 in. rainfall. This rainfall did not result in failure of the dam. Upstream slope tension crack appeared in late November or early December, probably as a result of reservoir drawdown.
MAINTENANCE OPERATION RECORDS	Reservoir records are available; the individual who measures the reservoir level also walks the crest of the dam on the same site visit to the dam.

Name of Dam: CANONSBURG DAM No. 2 (Johnsons Run Dam)

NDI # PA 00506

ITEM	REMARKS
SPILLWAY PLAN	See Plates 3, 6, and 7. Note that the end of the spillway was modified during construction.
SECTIONS	See Plate 6
DETAILS	See Plate 6
OPERATING EQUIPMENT PLANS & DETAILS	See Plate 5 of this report.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1.54 sq.mi. (primarily low-density residential)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1030.8 ft. (850 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1035.0 ft. (1040 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1035.0 ft.

CREST: Spillway

a. Elevation 1030.8 ft.
b. Type Concrete ogee weir
c. Width of Crest Parallel to Flow 2.5 ft.
d. Length of Crest Perpendicular to Flow 34.5 ft.
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS: Low level and upper level intakes

a. Type Low level-16 in. dia. C.I.P.; upper level-12 in. dia. C.I.P.
b. Location Center of embankment
c. Entrance inverts El. 1001.8 ft. and El. 1018.3 ft.
d. Exit inverts El. 992.8 ft.
e. Emergency draindown facilities Outlet works described above serve as emergency drawdown facilities

HYDROMETEOROLOGICAL GAGES: _____

a. Type Rain gauge
b. Location At water filtration plant downstream of reservoir
c. Records Weekly pool records are available

MAXIMUM NON-DAMAGING DISCHARGE Unknown

APPENDIX C

PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam

Top Photo (OV-T) - View of Upstream Slope from Left Abutment (Spillway is at right end of dam. Note the location of the tension crack on the upstream face)

Bottom Photo (OV-B) - View of Crest and Downstream Slope of Dam (Modification of downstream slope under construction at the time of inspection)

Photograph Location Plan

Photo 1 - View of Spillway Approach and Overflow Weir

Photo 2 - View of Downstream End of Spillway Chute Channel, End Sill, and Discharge Basin

Photo 3 - View of Spillway Overflow Weir and Training Wall

Photo 4 - Close-up View of Junction of the Embankment and Spillway (Note condition of the spillway training wall at normal pool level)

Photo 5 - Close-up View of Spillway Training Wall Joint

Photo 6 - View of Low Area to the Right (Abutment) Side of the Spillway

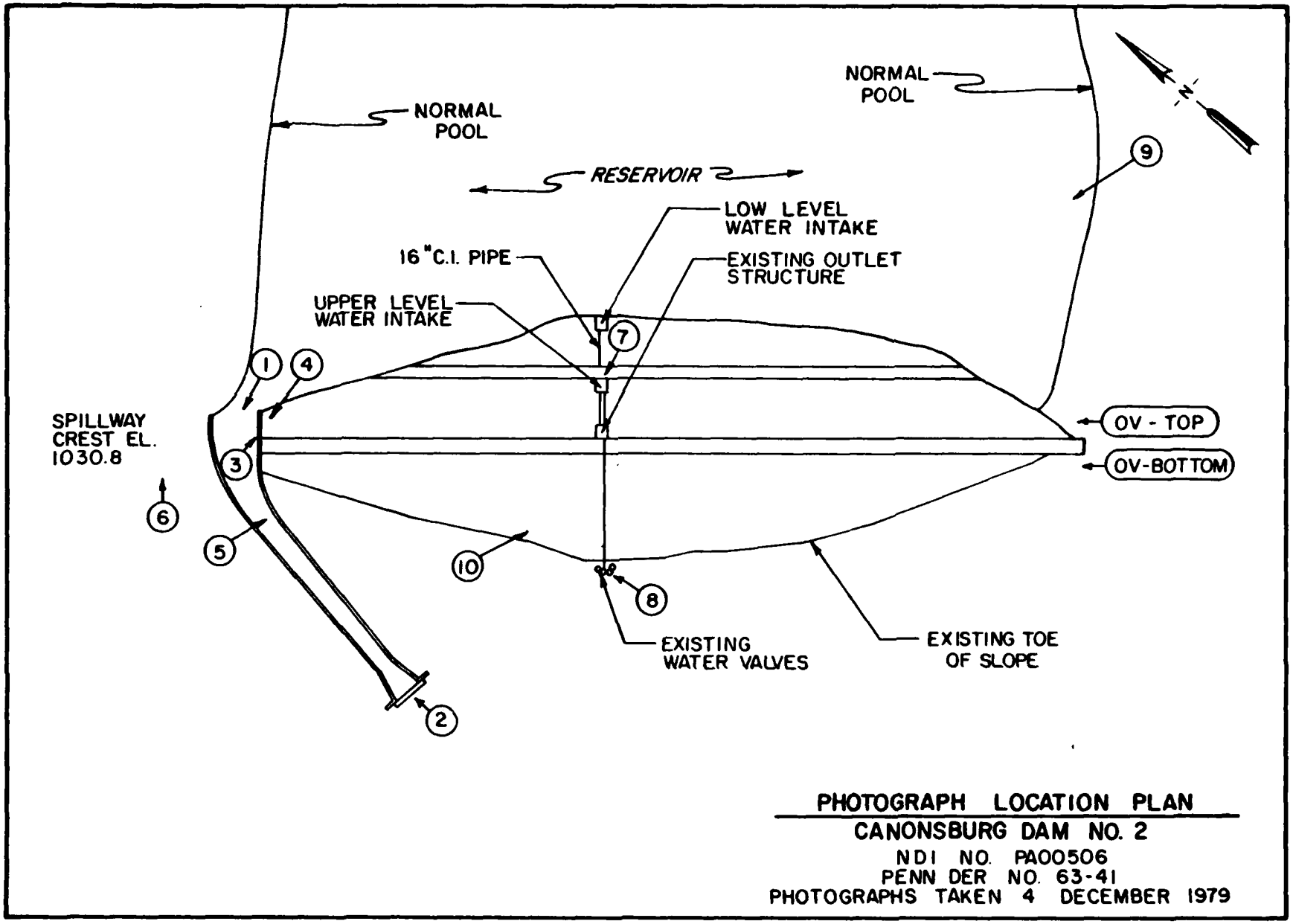
Photo 7 - View of Upper Level Water Intake

Photo 8 - View of Downstream Valve Boxes and Outlet (Note: These were to be modified during the downstream slope modification)

Photo 9 - View of Upstream Slope with Tension Crack

Photo 10 - View of Slide on Downstream Slope (Corrections under construction)

Note: Photographs were taken on 4 December 1979.



PHOTOGRAPH LOCATION PLAN

CANONSBURG DAM NO. 2

NDI NO. PA00506
PENN DER NO. 63-41
PHOTOGRAPHS TAKEN 4 DECEMBER 1979

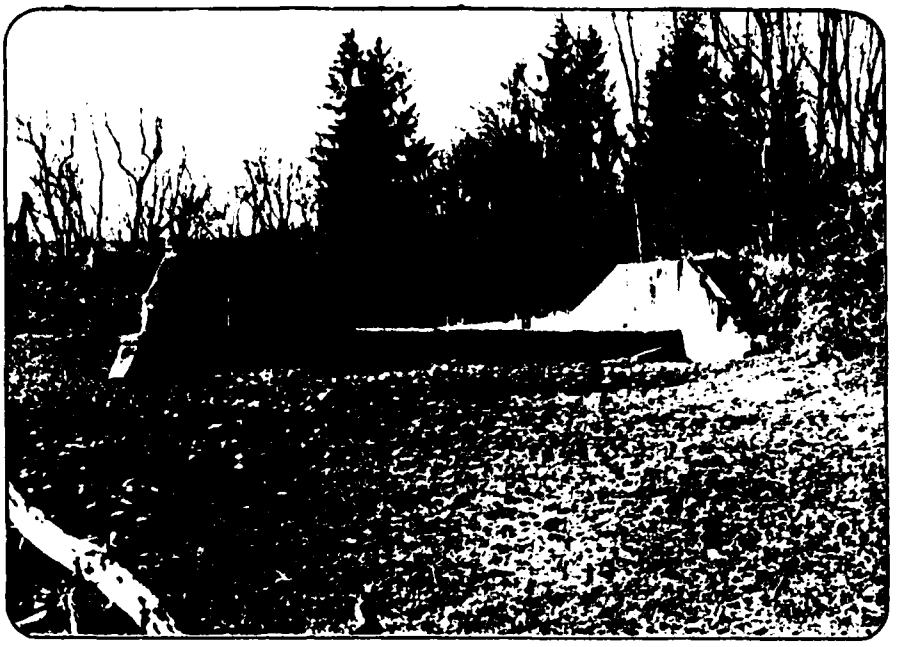


PHOTO 1. View of Spillway Approach and Overflow Weir

PHOTO 2. View of Downstream End of Spillway Chute Channel, End Sill, and Discharge Basin

PHOTO 3. View of Spillway Overflow Weir and Training Wall

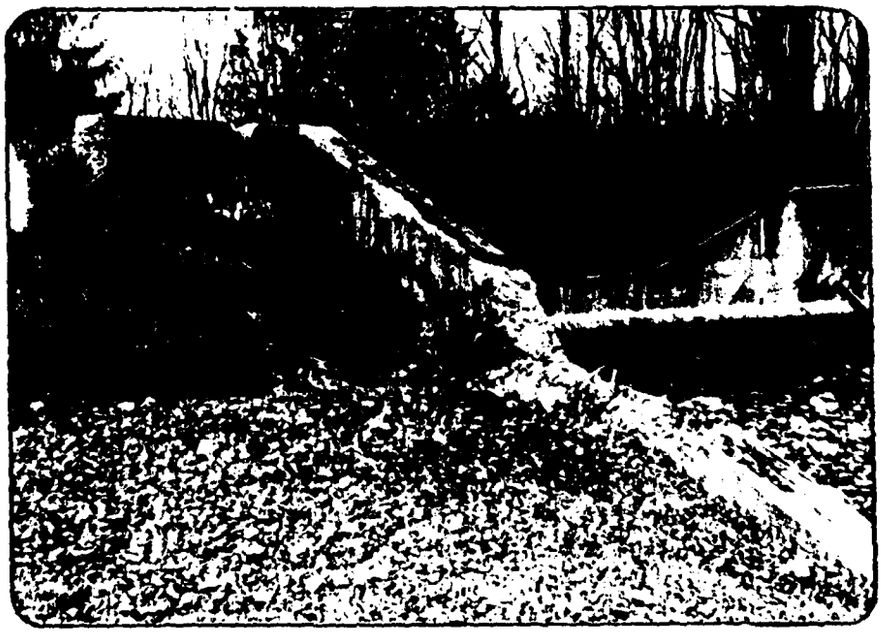


PHOTO 4. Close-up View of Junction of the Embankment and Spillway

PHOTO 5. CLose-up View of Spillway Training Wall Joint

PHOTO 6. View of Low Area to the Right (Abutment) Side of the Spillway

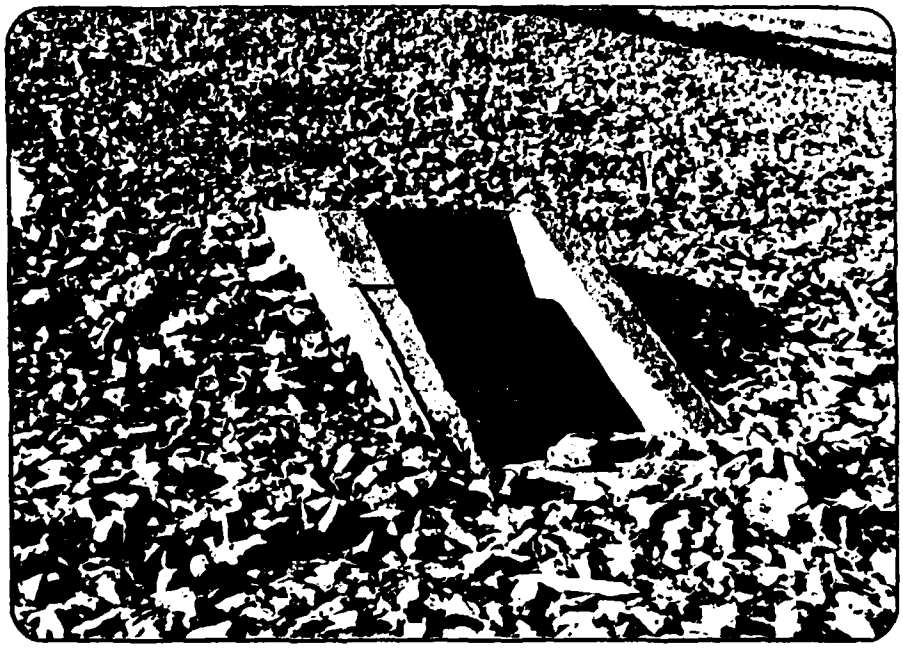


PHOTO 7. View of Upper Level Water Intake

PHOTO 8. View of Downstream Valve Boxes and Outlet

PHOTO 9. View of Upstream Slope with Tension Crack

PHOTO 10. View of Slide on Downstream Slope

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject ANONESUCK DAM NO. 2 S.O. No.
APPENDIX D - HYDROLOGIC AND Sheet No. of
HYDRAULIC ANALYSIS Drawing No.
Computed by Checked by Date

TABLE OF CONTENTS

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: CANONSBURG DAM No. 2

PROBABLE MAXIMUM PRECIPITATION (PMP) = 37.5 INCHES/72 HOURS

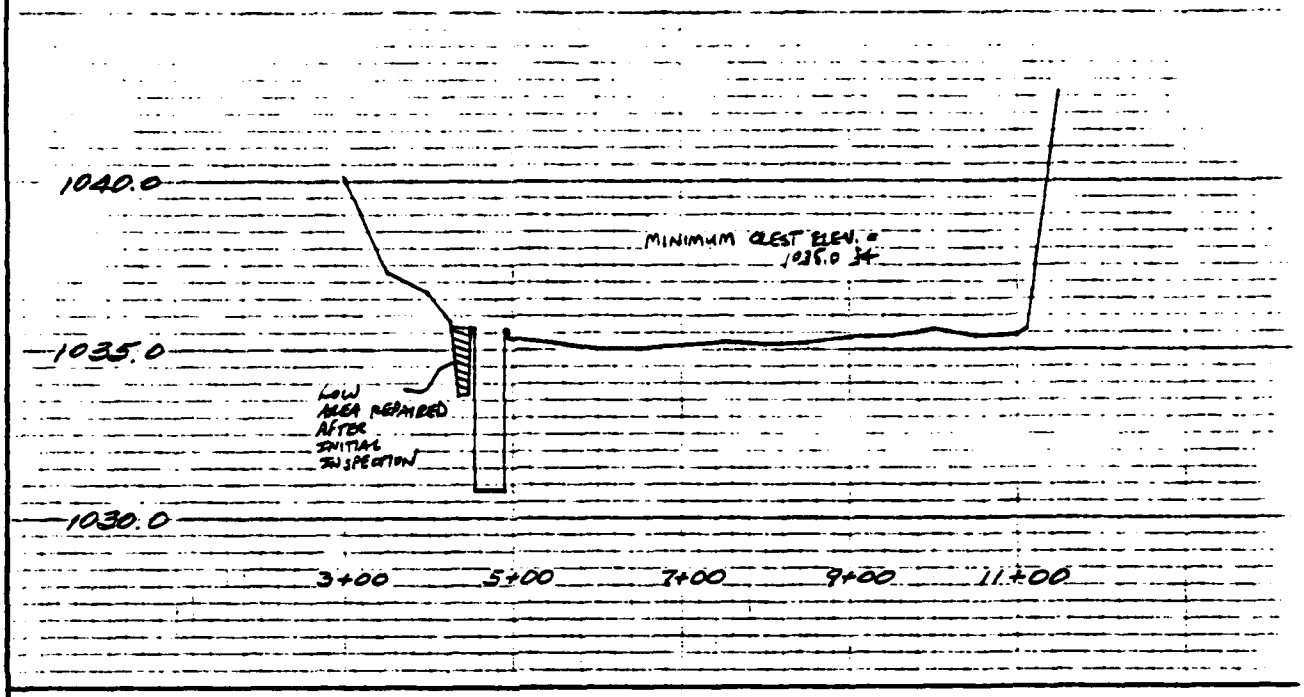
STATION	1	2	3	4	5
Station Description	UPPER BASIN	CANONSBURG DAM No. 2			
Drainage Area (square miles)	1.06	0.48			
Cumulative Drainage Area (square miles)	1.06	1.54			
Adjustment of PMF for Drainage Area (%) (1)					
6 Hours	71	71			
12 Hours	81	81			
24 Hours	87	87			
48 Hours	96	96			
72 Hours	100	100			
Clark Hydrograph Parameters(1)					
T_c (Hours)	2.27	2.00			
R (Hours)	6.20	5.46			
Spillway Data					
Crest Length (ft)		34.5			
Freeboard (ft)		5.0			
(DISCHARGE RATING CALCULATED BY BURGESS AND NIPLE)					

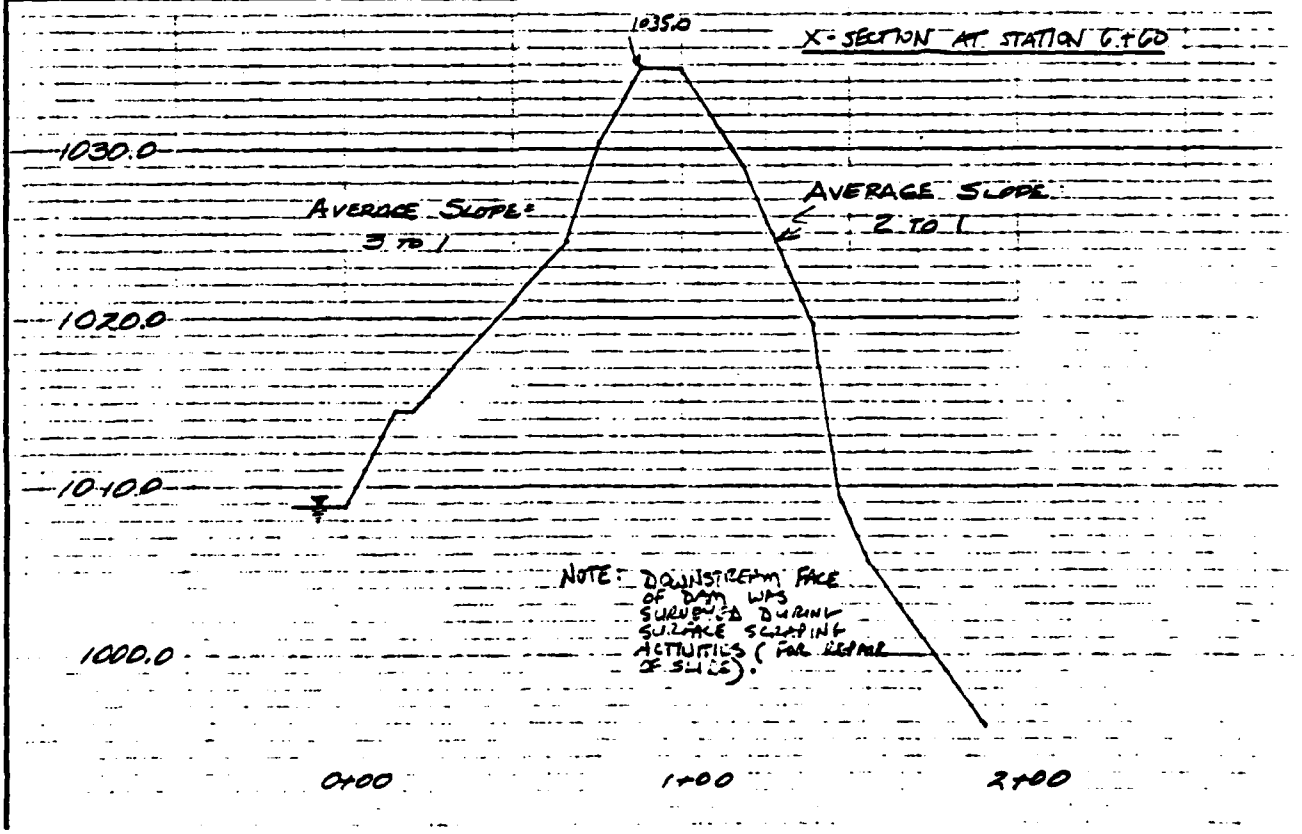
(1) From Burgess and Niple Analysis.

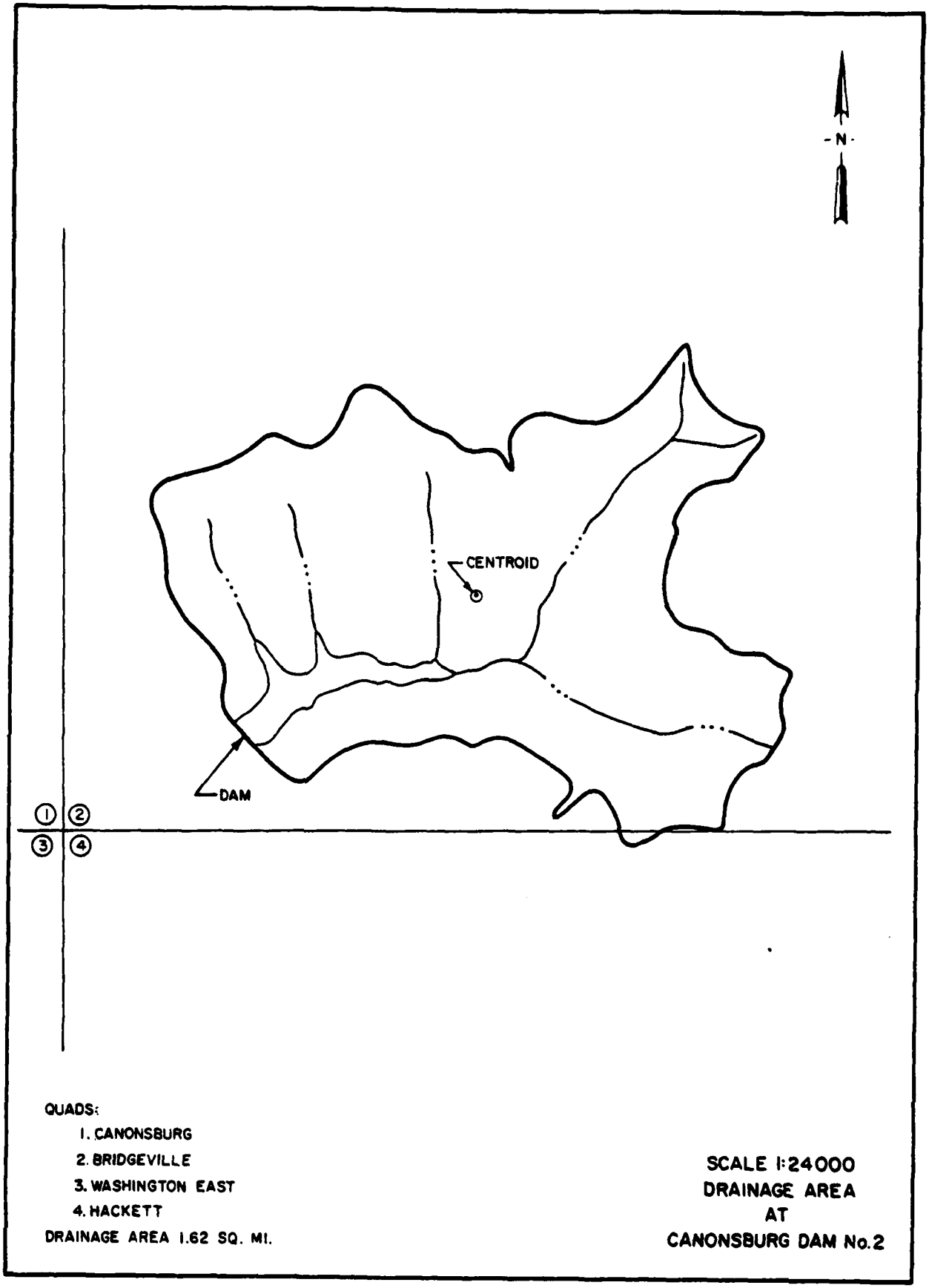
MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject CANONSBURG DAM NO. 2 S.O. No.
CREST PROFILE AND CROSS SECTION Sheet No. 2 of 28
Drawing No.
Computed by WLS Checked by WDL Date DEC. 4, 1979







QUADS:

1. CANONSBURG
2. BRIDGEVILLE
3. WASHINGTON EAST
4. HACKETT

DRAINAGE AREA 1.62 SQ. MI.

SCALE 1:24000
DRAINAGE AREA
AT
CANONSBURG DAM No.2

Burgess & Niple, Limited
January 26, 1979

SPEER'S RUN
CANONSBURG DAM NO. 1
Synopsis of
FLOOD ROUTING RESULTS

The total drainage area at Dam No. 1 is 2.92 square miles, while the drainage area at the upstream Dam No. 2 is 1.54 square miles. Probable maximum precipitation for the total drainage basin was derived from Hydrometeorological Report No. 51, "Probable Maximum Precipitation Estimates, United States East of the 105th Meridian", prepared by the National Weather Service in June, 1978. Appropriate precipitation losses for the basin were determined from charts provided by Pittsburgh District, Corps of Engineers. The resulting total rainfall and runoff for a 72 hour probable maximum storm were 30.00 and 26.5 inches, respectively. The similar values computed for a storm of one-half the probable maximum were 15.0 and 12.0 inches, respectively.

Runoff hydrographs from the watershed were computed by the unit hydrograph method. The Pittsburgh District Corps of Engineers supplied six hour duration unit hydrographs for various locations in the Chartiers Creek basin which they had developed for a previous study. Five of these unit hydrographs, with drainage areas ranging from 2.68 to 49.77 square miles, were then transformed to Dam No. 2, since its drainage area is nearly the same as the area between Dams Nos. 1 and 2. The transformation was done using a procedure developed by Gert Aron and Arthur Miller at Pennsylvania State University and presented in the American Water Resources Association Bulletin of April, 1978, under the title of "Adaptation of Flood Peaks and Design Hydrographs from Gaged to Nearby Ungaged Watersheds". In order to provide better definition to the flood hydrographs, one hour duration unit hydrographs were then derived from the dam site six hour duration unit hydrographs by the S-curve method. Finally, the one hour duration unit hydrographs were proportioned into unit hydrographs representing runoff from the following subareas: above the road crossing of Reservoir 2, from the road crossing to Dam No. 2, from Dam No. 2 to the Water Dam Road bridge over Speers Run, from the bridge to the normal pool headwaters of Reservoir 1, and from there to

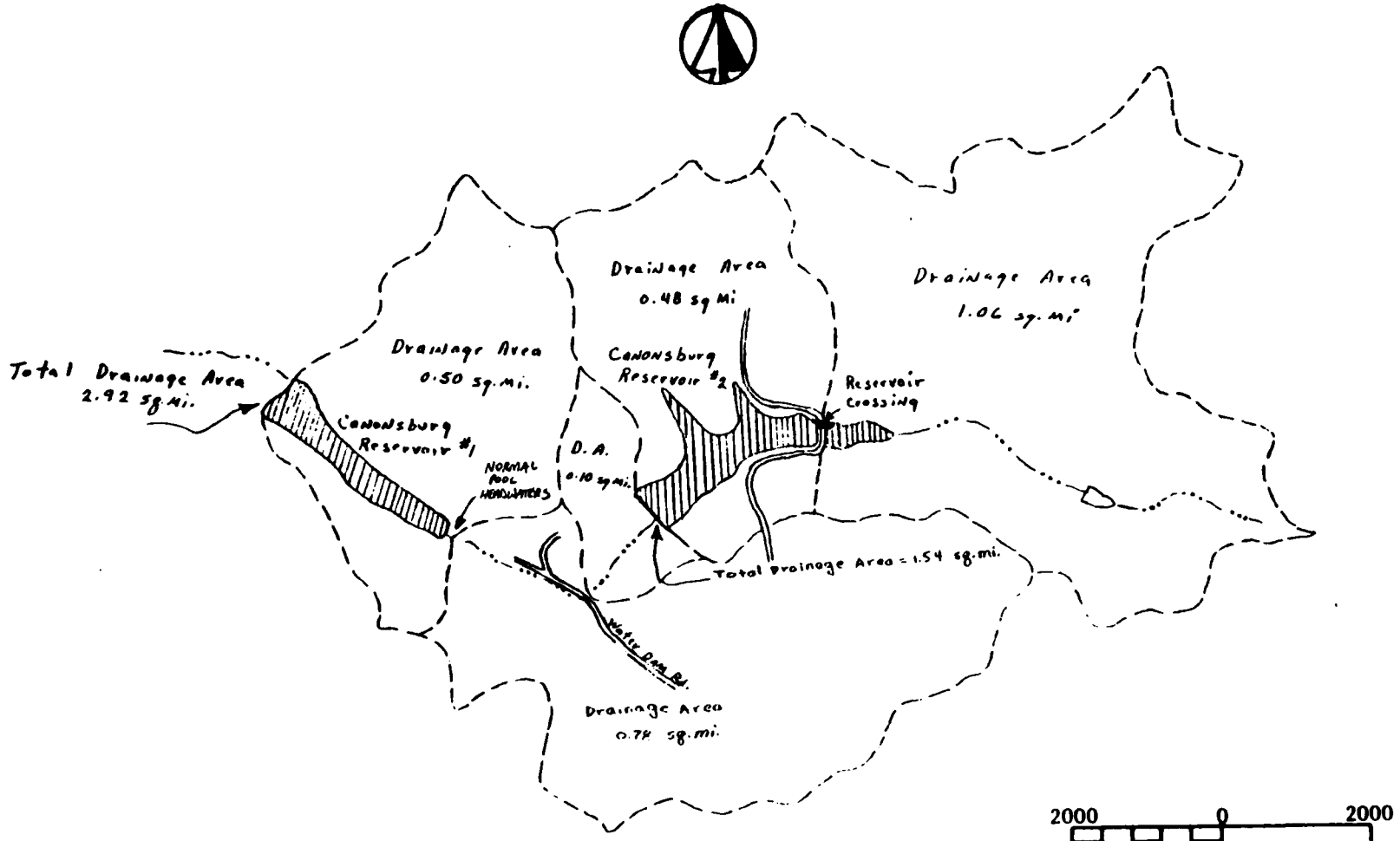
Dam No. 1. This final step was done in order to perform flood routing computations through the total stream hydrologic system.

Elevation versus storage data were derived from the two-foot contour interval topographic maps of the reservoirs and total stream system that were flown for this study. Elevation versus discharge data for flow over the spillways, and also over the dams, were determined by using the HEC-2, Water Surface Profiles, computer program. This method was used in order to reflect any influence of tailwater submergence on the discharge ratings. The spillway capacity at Dam No. 2 was found to be 890 cubic feet per second at the top of dam, Elevation 1035, and at Dam No. 1 was 1,945 cubic feet per second at the top of dam, Elevation 969. The HEC-2 program was also used to determine the discharge rating data for the road crossing of Reservoir 2 and for the stream system between Dams Nos. 1 and 2.

Flood runoff hydrograph routing computations were performed using the HEC-1, Flood Hydrograph Package (Dam Safety version), computer program. The peak discharge of the inflow hydrograph for the probable maximum flood (PMF) at Dam No. 2 was found to be 2,040 cubic feet per second and for the one-half PMF it was 1,002 cubic feet per second. The same peak inflow discharges at Dam No. 1 were found to be 3,924 and 1,599 cubic feet per second, respectively. Assuming that flow could occur over dams without their failing, the maximum water surface elevations for the PMF and one-half PMF at Dam No. 2 were 1035.9 and 1034.8, while at Dam No. 1 the similar elevations were 969.9 and 968.5. Therefore neither dam would be overtopped by the one-half PMF, but they both would be overtopped by the PMF.

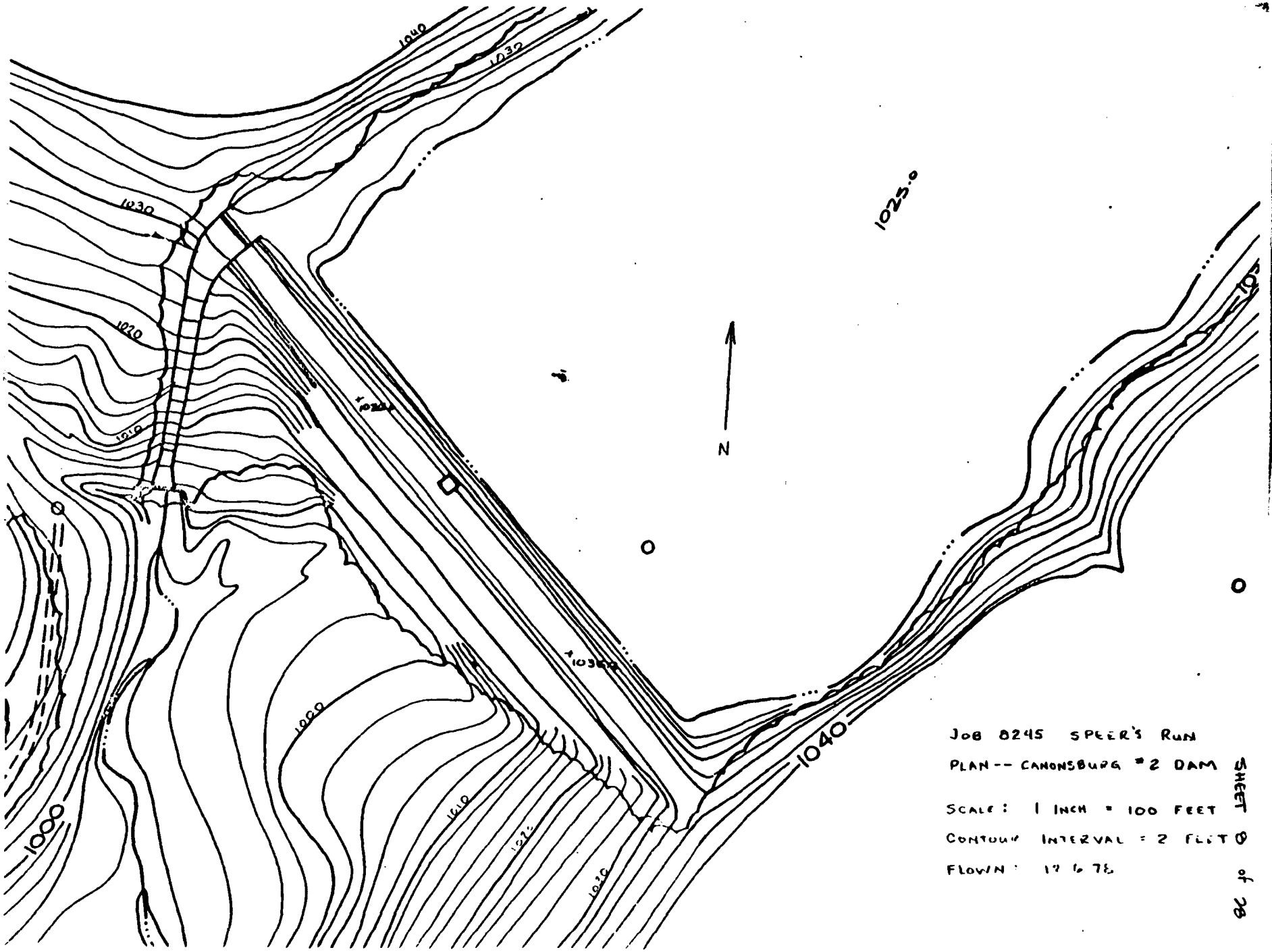
An analysis to determine the height of dams necessary to prevent PMF overtopping while employing the existing spillways was performed by considering flow over the spillways only. The resulting PMF maximum water surface elevations at Dams Nos. 2 and 1 were 1037.6 and 971.0, respectively. Thus, Dam No. 2 would have to be raised 2.6 feet and Dam No. 1 two feet to contain the PMF.

An alternative analysis to determine the height of Dam No. 1 necessary to prevent PMF overtopping while employing its existing spillway was performed by considering flow over its spillway only, but allowing flow at Dam No. 2 to be over the spillway and dam. The resulting PMF maximum water surface elevation at Dam No. 1 was 971.3, some 0.3 foot higher then if Dam No. 2 was also raised to contain the flow to its existing spillway. This alternative analysis does not reflect what would happen if Dam No. 2 were to fail when it is overtopped during the PMF.



Speers Run
Watershed Map

SHEET 7 OF 28



Job 8245 SPEER'S RUN

PLAN -- CANONSBURG #2 DAM

SCALE: 1 INCH = 100 FEET

CONTOUR INTERVAL = 2 FEET

FLOWN: 12 6 78

SHEET 8 of 38

Burgess & Niple, Limited
April 25, 1979

SPEER'S RUN
CANONSBURG DAM NO. 1

Synopsis of
FLOOD ROUTING RESULTS

SUPPLEMENT

Adjustments to flood routing computations were made subsequent to modifications in unit hydrograph derivation for the various tributary subareas. Unit hydrograph analysis was revised using optimization routines of the HEC-1, Flood Hydrograph Package, computer program and procedures suggested in the HEC-1 User's Manual to improve regional consistency. Only changes made to the previous flood hydrograph analysis are included in the following discussion.

Five unit hydrographs (six hour durations) which were analyzed in previous work were used to derive one hour unit hydrographs for those same locations. These derivations provided best-fit optimization without any predetermined restrictions and resulted in optimum Clark unit hydrograph coefficients. The computed times of concentration TC and storage coefficients R were combined into ratios, R/(TC+R), and the average regional ratio of 0.732 was determined. One hour unit hydrographs were redetermined from the five original six hour unit hydrographs to give new TC and R values for each drainage area based on the regional ratio. The sums TC+R from the second optimization were correlated to the respective drainage areas (DA), providing the equation:

$$TC+R = 8.39\ DA^{0.16} \qquad \text{(Eq. 1)}$$

Solving the average regional ratio equation for R and substituting the result into equation 1, the time of concentration, in hours, is:

$$TC = 2.25\ DA^{0.16} \qquad \text{(Eq. 2)}$$

Clark times of concentration and storage coefficients for the various subareas in the flood routing system were then computed from equations 1 and 2 and were used for flood hydrograph computation.

Revised flood hydrograph routing computations were performed using Clark subarea TC and R values for unit hydrograph definition in the HEC-1, Flood Hydrograph Package (Dam Safety Version), computer program. The peak inflow at Dam No. 2 for the probable maximum flood (PMF) would be 2,350 cubic feet per second while that for the one-half PMF would be 1,160 cubic feet per second. Corresponding inflows at Dam No. 1 would be 4,520 cubic feet per second and 1,870 cubic feet per second. Assuming that flow could occur over both dams without their failure, the maximum water surface elevations for the PMF and one-half PMF at Dam No. 2 would be 1,036.0 and 1,035.1 while at Dam No. 1 the elevations would be 970.1 and 968.8. Both dams would be overtopped by the PMF, while only Dam No. 2 would be overtopped by the one-half PMF and this by only 0.1 foot. Table 1 summarizes the existing condition flood routing results.

Table 1

EXISTING CONDITION FLOOD ROUTING RESULTS

	Speers Run Dam (Canonsburg No. 1)		Canonsburg No. 2	
	PMF	1/2 PMF	PMF	1/2 PMF
Peak Inflow (cfs)	4,520	1,870	2,350	1,160
Maximum Reservoir Elevation (feet)	970.1	968.8	1,036.0	1,035.1
Peak Outflow (cfs)	4,520	1,845	2,350	960
Through Spillway	2,750	1,845	1,220	930
Over Dam Embankment	1,770	0	1,130	30
Depth of Overtopping (feet)	1.1	-	1.0	0.1
Freeboard (feet)	-	0.2	-	-
Duration of Overtopping (hours)	9	-	11	2

An analysis to determine the height of dams necessary to prevent PMF overtopping while employing the existing spillways was performed by considering flow over the spillways only. The resulting PMF maximum water surface elevations at Dam Nos. 2 and 1 were 1,038.2 and 971.6, respectively. Thus Dam No. 2 would have to be raised 3.2 feet and Dam No. 1 2.6 feet to contain the PMF.

An alternative analysis to determine the height of Dam No. 1 necessary to prevent PMF overtopping while employing its existing spillway was performed by considering flow over its spillway only, but allowing flow at Dam No. 2 over the spillway and dam. The resulting PMF maximum water surface elevation at Dam No. 1 was 972.3, some 0.7 foot higher than if Dam No. 2 was also raised to contain the flow to its existing spillway. This alternative analysis does not reflect what would happen if Dam No. 2 were to fail when it is overtopped during the PMF.

Comparisons of flood routing results from this revised analysis to the results from the previous analyis appear in Table 2.

Table 2

COMPARISON OF FLOOD ROUTING RESULTS

	Speer's Run Dam (Canonsburg No. 1)		Canonsburg No. 2	
	PMF	1/2 PMF	PMF	1/2 PMF
Existing Peak Inflow (cfs)				
Revised	4,520	1,870	2,350	1,160
Previous	3,924	1,599	2,040	1,002
Change	596	271	310	158
Existing Stage (feet)				
Revised	970.1	968.8	1,036.0	1,035.1
Previous	969.9	968.5	1,035.9	1,034.8
Change	0.2	0.3	0.1	0.3
Plan A Stage (feet)[a]				
Revised	971.6	-	1,038.2	-
Previous	971.0	-	1,037.6	-
Change	0.6	-	0.6	-
Plan B Stage (feet)[b]				
Revised	972.3	-	1,036.0	-
Previous	971.3	-	1,035.9	-
Change	1.0	-	0.1	-

(a) Plan A assumes no flow over either dam
(b) Plan B assumes no flow over Canonsburg No. 1

```
A1      SPEER S RUN DAM     JOB 8285            JUNE 1979     G. BIEMEL
A2      ROUTE PMF AND 1/2 PMF THROUGH SYSTEM
A3      DAMS OVERTOP BUT DO NOT FAIL
B    300              15                                                  8
B1     5
J      1        2
J11.0   0.5
K      0        1                                    1
K1      INFLOW: CANONSBURG NO. 2, UPPER BASIN  D.A.=1.06 SQ. MI.
M      1        1.06            2.92                                     1
P       37.5    71.     81.     87.     96.     100.
T                                               2.2     0.029
V 2.27  6.20
X
K      1        2                       1       1
K1      ROUTE THROUGH CULVERT AT UPSTR END OF CANONSBURG NO.2
T                               1       1
Y1     1                                        -1030.0         -1
Y41036.81033.1  1034.7  1035.6  1035.9  1036.0  1036.1  1036.2  1036.4  1036.5
Y50.    100.    360.    540.    721.    901.    1081.   1261.   1441.   1621.
S30.    7.      14.     28.     49.     82.     123.    155.
SE1023.71025.   1027.3  1030.   1032.5  1035.   1037.5  1040.
S31023.7
SD1035.1
SR5.    1.      1026.8  0.5     1030.8  1050.
K      0        2                               1
K1      INFLOW: CANONSBURG NO. 2, DIRECT DRAINAGE  D.A.=0.48 SQ. MI.
M      1        0.48            2.92                                     1
P       37.5    71.     81.     87.     96.     100.
T                                               2.2     0.029
V 2.00  5.46
X
K      2        2                       1       1
K1      TOTAL INFLOW TO CANONSBURG NO. 2
K      1    DAM2                       1       1
K1      ROUTE THROUGH CANONSBURG NO. 2
Y                               1       1
Y1     1                                        -1030.0         -1
Y41030.81031.8  1033.0  1034.0  1035.0  1035.3  1035.6  1035.6  1036.1  1036.4
Y50.    100.    300.    590.    890.    1050.   1145.   1500.   2740.   3700.
S30.    20.     70.     155.    279.    435.    660.    827.    960.    1240.
SE995.  1000.   1005.   1010.   1015.   1020.   1025.   1030.   1034.   1040.
S31030.8
SD1035.
SR20.   1.      998.5   0.5     1030.8  1050.
K      1        0                       1       1
K1      TAILWATER STAGES AT CANONSBURG NO. 2
Y                               1       1
Y1     1                                        -1
Y20.    0.1     0.3
Y30.    7000.   30000.
Y4990.0 996.5   997.0   997.5   997.7   998.0   998.2   998.5   999.0   1005.8
Y41011.81016.1
Y50.    55.     105.    300.    400.    610.    790.    1090.   1680.   10000.
Y520000.30000.
K      0        0                               1
K1      INFLOW: CANONSBURG NO. 1, UPPER AREA  D.A.=0.10
M      1        0.10            2.92                                     1
P       37.5    71.     81.     87.     96.     100.
T                                               2.2     0.029
V 1.55  4.25
X
```

BURGESS AND NIPLE

COMPUTER ANALYSIS

NOTE: HEC-2 WAS USED BY BURGESS AND NIPLE TO COMPUTE RATING CURVE INFORMATION

(ANALYSIS OF AREA DOWNSTREAM OF CANONSBURG DAM NO. 2 NOT INCLUDED WITH THIS REPORT)

SHEET 13 OF 28

Note: Storage vs. elevation rating curve used for this report was supplied by Burgess & Niple, Inc.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 79/07/03.
     TIME= 11.59.03.
```

SPEER S RUN DAM JOB 8245 JUNE 1979 G. SIEMEL
ROUTE PMF AND 1/2 PMF THROUGH SYSTEM
DAMS OVERTOP BUT DO NOT FAIL

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 0

RTIOS= 1.00 .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW: CANONSBURG NO. 2, UPPER BASIN D.A.=1.06 SQ. MI.

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	1.06	0.00	2.92	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	37.50	71.00	81.00	87.00	96.00	100.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	2.20	.03	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 2.27 R= 6.20 NTA= 8

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 2.28 HOURS, CP= .30 VOL= .98

3.	11.	22.	35.	51.	65.	77.	86.	91.	91.
87.	84.	80.	77.	74.	71.	68.	66.	63.	61.
58.	56.	54.	52.	50.	48.	46.	44.	42.	40.
39.	37.	36.	34.	33.	32.	31.	29.	28.	27.
26.	25.	24.	23.	22.	21.	20.	20.	19.	18.

SHEET H OF 23

17.	17.	16.	15.	15.	14.	14.	13.	13.	12.	
12.	11.	11.	10.	10.	9.	9.	9.	8.	8.	
8.	7.	7.	7.	7.	6.	6.	6.	6.	5.	
5.	5.	5.	5.	4.	4.	4.	4.	4.	4.	
3.	3.	3.	3.	3.	3.	3.	3.	3.	2.	

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	30.00	26.55	3.45	70720.
										(762.)(	674.)(	88.)(	2002.57)

TOTAL RAIN 30.00, TOTAL RAINFALL EXCESS 26.55, TOTAL FLOW 70720.

TOTAL RAIN 15.00, TOTAL RAINFALL EXCESS 12.05, TOTAL FLOW 32106.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH CULVERT AT UPSTR END OF CANONSBURG NO.2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	1	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1031.	-1

STAGE	1030.00	1033.10	1034.70	1035.60	1035.90	1036.00	1036.10	1036.20	1036.40	1036.50
FLOW	0.00	180.00	360.00	540.00	721.00	901.00	1081.00	1261.00	1441.00	1621.00
CAPACITY=	0.	7.	14.	28.	49.	82.	123.	155.		
ELEVATION=	1024.	1025.	1027.	1030.	1033.	1035.	1038.	1040.		

CREL	SPWID	COON	EXPW	ELEVL	COOL	CAREA	EXPL
1023.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1035.1	0.0	0.0	0.

DAM BREACH DATA

BRWID	I	ELBM	TFAIL	WSEL	FAILEL
5.	1.00	1024.80	.50	1030.80	1050.00

STATION 2, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

SHEET 15 OF 28

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
2.	3.	5.	7.	10.	13.	15.	18.	20.	22.
23.	24.	24.	24.	24.	24.	24.	24.	23.	23.
22.	21.	21.	20.	19.	19.	18.	18.	17.	17.
16.	16.	16.	17.	17.	18.	19.	20.	21.	22.
23.	25.	26.	27.	28.	29.	31.	32.	33.	34.
35.	36.	38.	39.	42.	45.	48.	53.	58.	64.
71.	78.	85.	93.	100.	107.	115.	122.	129.	135.
140.	144.	149.	154.	159.	164.	171.	178.	189.	204.
223.	245.	270.	300.	332.	373.	433.	488.	538.	683.
888.	1031.	1150.	1267.	1341.	1427.	1528.	1572.	1589.	1592.
1587.	1573.	1549.	1517.	1477.	1435.	1408.	1354.	1306.	1256.
1192.	1150.	1109.	1069.	1031.	994.	959.	925.	893.	861.
831.	803.	775.	748.	722.	709.	689.	666.	643.	619.
595.	572.	549.	535.	525.	513.	499.	486.	469.	454.
438.	423.	405.	387.	371.	357.	348.	339.	329.	319.
309.	299.	288.	278.	268.	259.	249.	240.	231.	222.
213.	205.	197.	189.	182.	176.	171.	166.	160.	155.
150.	145.	140.	135.	129.	122.	116.	110.	105.	101.
97.	93.	89.	86.	83.	81.	79.	78.	76.	74.
73.	72.	72.	71.	70.	70.	69.	67.	66.	65.
63.	62.	60.	58.	57.	55.	53.	51.	49.	47.
46.	44.	42.	41.	39.	37.	36.	35.	33.	32.
30.	29.	28.	27.	26.	25.	24.	23.	22.	21.

STORAGE

35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	36.	36.	36.	37.	37.	37.
37.	37.	37.	37.	37.	37.	37.	37.	37.	37.
37.	37.	37.	37.	37.	37.	37.	37.	37.	37.
36.	36.	36.	37.	37.	37.	37.	37.	37.	37.
37.	37.	37.	38.	38.	38.	38.	38.	38.	38.
38.	39.	39.	39.	39.	40.	40.	40.	41.	42.
42.	43.	44.	45.	45.	46.	47.	48.	49.	49.
50.	51.	52.	53.	53.	54.	55.	57.	58.	60.
62.	65.	68.	71.	75.	79.	83.	87.	92.	96.
98.	100.	101.	102.	103.	105.	106.	106.	106.	106.
106.	106.	106.	106.	105.	105.	104.	103.	102.	102.
101.	101.	100.	100.	100.	99.	99.	99.	98.	98.
98.	98.	97.	97.	97.	96.	96.	95.	95.	94.
93.	93.	92.	91.	91.	90.	88.	87.	86.	85.
83.	82.	81.	80.	79.	78.	77.	76.	74.	73.
72.	71.	70.	68.	67.	66.	65.	64.	63.	62.
61.	60.	59.	58.	57.	56.	55.	54.	50.	53.
52.	51.	50.	49.	49.	48.	47.	47.	46.	46.
45.	45.	44.	44.	44.	43.	43.	43.	43.	43.
43.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	41.	41.	41.	41.	41.	40.	40.	40.	40.
40.	39.	39.	39.	39.	39.	39.	38.	38.	38.
38.	38.	38.	38.	37.	37.	37.	37.	37.	37.

STAGE

1030.8	1030.8	1030.8	1030.8	1030.8	1030.8	1030.8	1030.8	1030.8	1030.8
1030.8	1030.8	1030.8	1030.8	1030.8	1030.8	1030.8	1030.8	1030.8	1030.8

SHEET 16 OF 25

SHEET 17 OF 28

```
        1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
        1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
        1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
        1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
        1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
        1030.8    1030.8    1030.9    1030.9    1030.9    1031.0    1031.0    1031.0    1031.1    1031.1
        1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1
        1031.1    1031.1    1031.1    1031.1    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0
        1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.1    1031.1    1031.1
        1031.1    1031.1    1031.1    1031.1    1031.2    1031.2    1031.2    1031.2    1031.2    1031.2
        1031.2    1031.3    1031.3    1031.3    1031.3    1031.4    1031.4    1031.5    1031.5    1031.6
        1031.7    1031.8    1031.9    1032.0    1032.1    1032.2    1032.3    1032.4    1032.5    1032.5
        1032.6    1032.6    1032.7    1032.8    1032.8    1032.9    1033.0    1033.1    1033.2    1033.3
        1033.5    1033.7    1033.9    1034.2    1034.5    1034.8    1035.1    1035.3    1035.6    1035.8
        1036.0    1036.1    1036.1    1036.2    1036.3    1036.4    1036.4    1036.5    1036.5    1036.5
        1036.5    1036.5    1036.5    1036.4    1036.4    1036.4    1036.4    1036.3    1036.2    1036.2
        1036.2    1036.1    1036.1    1036.1    1036.1    1036.1    1036.0    1036.0    1036.0    1036.0
        1036.0    1035.9    1035.9    1035.9    1035.9    1035.9    1035.8    1035.8    1035.8    1035.7
        1035.7    1035.7    1035.6    1035.6    1035.5    1035.5    1035.4    1035.3    1035.2    1035.2
        1035.1    1035.0    1034.9    1034.8    1034.8    1034.7    1034.6    1034.5    1034.4    1034.3
        1034.2    1034.2    1034.1    1034.0    1033.9    1033.8    1033.7    1033.6    1033.6    1033.5
        1033.4    1033.3    1033.3    1033.2    1033.1    1033.0    1033.0    1032.9    1032.8    1032.8
        1032.7    1032.7    1032.6    1032.5    1032.4    1032.4    1032.3    1032.2    1032.1    1032.1
        1032.0    1032.0    1031.9    1031.9    1031.9    1031.8    1031.8    1031.8    1031.8    1031.7
        1031.7    1031.7    1031.7    1031.7    1031.7    1031.7    1031.7    1031.7    1031.6    1031.6
        1031.6    1031.6    1031.6    1031.5    1031.5    1031.5    1031.5    1031.5    1031.4    1031.4
        1031.4    1031.4    1031.3    1031.3    1031.3    1031.3    1031.3    1031.2    1031.2    1031.2
        1031.2    1031.2    1031.2    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1

 PEAK OUTFLOW IS     1592. AT TIME  42.50 HOURS

                          PEAK    6-HOUR    24-HOUR    72-HOUR   TOTAL VOLUME
               CFS       1592.     1353.       662.       245.         70605.
               CMS         45.       38.        19.         7.          1999.
            INCHES                 11.08      23.23      25.82          25.82
                MM                301.70     590.15     655.76         655.76
             AC-FT                  671.      1313.      1459.          1459.
        THOUS CU M                  828.      1619.      1799.          1799.


                                   STATION      2, PLAN 1, RATIO 2

                                END-OF-PERIOD HYDROGRAPH ORDINATES

                                            OUTFLOW
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        1.        2.        3.        5.        7.       10.       13.       16.       20.
           24.       28.       32.       36.       40.       44.       48.       54.       60.       69.
```

```
     79.       90.      104.      120.      136.      149.      163.      179.      204.      232.
    264.      300.      340.      399.      461.      516.      605.      692.      751.      777.
    773.      767.      755.      739.      720.      710.      691.      668.      645.      622.
    599.      578.      556.      538.      530.      519.      507.      494.      480.      466.
    452.      437.      423.      407.      391.      376.      362.      353.      344.      335.
    326.      316.      306.      296.      286.      277.      267.      257.      248.      239.
    230.      222.      213.      205.      198.      190.      183.      177.      172.      167.
    162.      157.      152.      147.      142.      137.      133.      126.      119.      113.
    108.      103.       98.       94.       89.       85.       82.       78.       75.       71.
     68.       65.       63.       60.       57.       55.       53.       50.       48.       46.
     44.       43.       41.       39.       38.       37.       35.       35.       34.       33.
     32.       31.       31.       31.       30.       29.       29.       28.       27.       27.
     26.       25.       24.       24.       23.       22.       21.       20.       20.       19.
     18.       17.       17.       16.       15.       15.       14.       14.       13.       13.
     12.       12.       11.       11.       10.       10.        9.        9.        9.        8.
                                         STORAGE
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       35.       35.       35.       35.
     35.       35.       35.       35.       35.       35.       36.       36.       36.       37.
     37.       38.       38.       39.       39.       39.       40.       41.       41.       42.
     43.       44.       46.       48.       50.       52.       54.       57.       60.       63.
     67.       71.       76.       81.       85.       90.       94.       96.       97.       97.
     97.       97.       97.       97.       97.       96.       96.       95.       95.       94.
     93.       93.       92.       92.       91.       90.       89.       88.       87.       86.
     85.       83.       82.       81.       80.       79.       78.       77.       76.       75.
     74.       73.       72.       71.       69.       68.       67.       66.       65.       64.
     63.       62.       61.       60.       59.       58.       57.       56.       56.       55.
     54.       53.       52.       51.       51.       50.       49.       48.       48.       47.
     46.       46.       45.       45.       44.       44.       43.       43.       43.       42.
     42.       42.       41.       41.       41.       41.       40.       40.       40.       40.
     39.       39.       39.       39.       39.       39.       39.       38.       38.       38.
     38.       38.       38.       38.       38.       38.       38.       38.       38.       38.
     37.       37.       37.       37.       37.       37.       37.       37.       37.       37.
     37.       37.       37.       36.       36.       36.       36.       36.       36.       36.
     36.       36.       36.       36.       36.       36.       36.       36.       36.       36.
                                          STAGE
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
  1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
```

SHEET 18 OF 28

1030.8	1030.8	1030.8	1030.8	1030.9	1030.9	1030.9	1031.0	1031.0	1031.1
1031.1	1031.2	1031.2	1031.3	1031.3	1031.4	1031.4	1031.5	1031.6	1031.7
1031.8	1032.0	1032.1	1032.3	1032.5	1032.7	1032.9	1033.1	1033.3	1033.6
1033.8	1034.2	1034.5	1034.9	1035.2	1035.5	1035.7	1035.9	1035.9	1035.9
1035.9	1035.9	1035.9	1035.9	1035.9	1035.9	1035.8	1035.8	1035.8	1035.7
1035.7	1035.7	1035.6	1035.6	1035.6	1035.5	1035.4	1035.4	1035.3	1035.2
1035.2	1035.1	1035.0	1034.9	1034.9	1034.8	1034.7	1034.6	1034.6	1034.5
1034.4	1034.3	1034.2	1034.1	1034.0	1034.0	1033.9	1033.8	1033.7	1033.6
1033.5	1033.5	1033.4	1033.3	1033.3	1033.2	1033.1	1033.1	1033.0	1032.9
1032.9	1032.8	1032.7	1032.7	1032.6	1032.6	1032.5	1032.4	1032.3	1032.2
1032.2	1032.1	1032.1	1032.0	1031.9	1031.9	1031.8	1031.8	1031.8	1031.7
1031.7	1031.6	1031.6	1031.6	1031.5	1031.5	1031.5	1031.4	1031.4	1031.4
1031.4	1031.3	1031.3	1031.3	1031.3	1031.3	1031.3	1031.2	1031.2	1031.2
1031.2	1031.2	1031.2	1031.2	1031.2	1031.2	1031.2	1031.2	1031.1	1031.1
1031.1	1031.1	1031.1	1031.1	1031.1	1031.1	1031.1	1031.1	1031.1	1031.0
1031.0	1031.0	1031.0	1031.0	1031.0	1031.0	1031.0	1031.0	1031.0	1031.0
1031.0	1030.9	1030.9	1030.9	1030.9	1030.9	1030.9	1030.9	1030.9	1030.9

PEAK OUTFLOW IS 777, AT TIME 42.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	777.	634.	315.	111.	32070.
CMS	22.	18.	9.	3.	908.
INCHES		5.57	11.05	11.73	11.73
MM		141.41	280.78	297.86	297.86
AC-FT		315.	625.	663.	663.
THOUS CU M		388.	770.	817.	817.

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW: CANONSBURG NO. 2, DIRECT DRAINAGE D.A.=0.48 SQ. MI.

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	.48	0.00	2.92	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	37.50	71.00	81.00	87.00	96.00	100.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .820

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	2.20	.03	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 2.00 R= 5.46 NTA= 0

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 2.01 HOURS, CP= .30 VOL= .99

SHEET 17 OF 23

2.	7.	14.	22.	31.	38.	44.	47.	46.	44.
42.	40.	39.	37.	35.	34.	32.	31.	29.	28.
27.	26.	24.	23.	22.	21.	20.	19.	19.	18.
17.	16.	15.	15.	14.	13.	13.	12.	12.	11.
11.	10.	10.	9.	9.	9.	8.	8.	7.	7.
7.	6.	6.	6.	6.	5.	5.	5.	5.	4.
4.	4.	4.	4.	4.	3.	3.	3.	3.	3.
3.	3.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	30.00	26.55	3.45	32351.
										(762.)(	674.)(	88.)(	916.00)

TOTAL RAIN 30.00, TOTAL RAINFALL EXCESS 26.55, TOTAL FLOW 32351.

TOTAL RAIN 15.00, TOTAL RAINFALL EXCESS 12.05, TOTAL FLOW 14686.

****

COMBINE HYDROGRAPHS

TOTAL INFLOW TO CANONSBURG NO. 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	2	0	0	0	1	1	0	0

SUM OF 2 HYDROGRAPHS AT 2 PLAN 1 RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	2.	4.
6.	10.	14.	19.	23.	27.	30.	33.	35.	36.
36.	37.	37.	36.	36.	35.	34.	33.	33.	32.
31.	30.	29.	28.	27.	26.	25.	24.	23.	23.
23.	24.	25.	26.	27.	29.	31.	32.	34.	36.
38.	40.	42.	43.	45.	47.	48.	50.	52.	53.
55.	57.	60.	64.	70.	77.	85.	94.	104.	115.
126.	137.	148.	159.	170.	181.	191.	202.	212.	221.
228.	235.	242.	250.	258.	268.	281.	299.	326.	359.
398.	443.	493.	547.	605.	672.	759.	838.	929.	1125.
1390.	1599.	1782.	1956.	2076.	2192.	2305.	2353.	2369.	2368.
2358.	2325.	2283.	2227.	2161.	2092.	2029.	1957.	1884.	1811.
1724.	1660.	1598.	1538.	1481.	1426.	1374.	1324.	1275.	1229.
1185.	1142.	1101.	1062.	1023.	998.	966.	931.	896.	861.
826.	793.	760.	737.	717.	697.	675.	652.	630.	607.
584.	562.	538.	515.	493.	474.	459.	445.	430.	416.
401.	387.	372.	359.	345.	332.	319.	306.	294.	282.
271.	260.	249.	239.	229.	222.	214.	207.	200.	193.
186.	179.	173.	167.	160.	152.	145.	139.	133.	128.
123.	119.	115.	112.	110.	108.	108.	108.	106.	105.
105.	105.	104.	103.	102.	100.	98.	96.	94.	92.

SWES - 20 OF 28

```
      89.       86.       84.       81.       78.       75.       72.       70.       67.       64.
      62.       59.       57.       55.       52.       50.       48.       46.       44.       42.
      40.       39.       37.       35.       34.       33.       31.       30.       29.       27.

                          PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                CFS      2369.     2003.      966.      357.       102953.
                CMS        67.       57.       27.       10.         2915.
             INCHES                12.10     23.34     25.91         25.91
                 MM               307.34    592.85    658.16        658.16
              AC-FT                 993.     1916.     2127.         2127.
         THOUS CU M                1225.     2363.     2624.         2624.


                     SUM OF 2 HYDROGRAPHS AT       2  PLAN 1  RTIO 2
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.        0.        1.
       2.        4.        6.       10.       14.       19.       24.       30.       35.       41.
      47.       53.       59.       65.       71.       78.       87.       98.      113.      130.
     151.      175.      202.      230.      259.      286.      314.      344.      388.      442.
     504.      573.      646.      733.      818.      889.      985.     1073.     1132.     1156.
    1148.     1134.     1114.     1086.     1054.     1030.      998.      963.      927.      892.
     858.      826.      794.      766.      749.      729.      708.      687.      665.      644.
     622.      601.      581.      558.      536.      515.      495.      480.      466.      451.
     437.      422.      407.      393.      379.      365.      351.      338.      325.      313.
     301.      289.      278.      267.      256.      246.      236.      228.      221.      213.
     206.      199.      193.      186.      179.      173.      166.      158.      150.      143.
     136.      129.      123.      118.      112.      107.      103.       98.       94.       90.
      86.       82.       79.       75.       72.       69.       66.       63.       61.       58.
      56.       54.       52.       50.       49.       48.       48.       47.       46.       46.
      45.       45.       44.       44.       43.       42.       41.       40.       38.       37.
      36.       35.       34.       32.       31.       30.       29.       28.       27.       26.
      25.       24.       23.       22.       21.       20.       19.       18.       17.       17.
      16.       15.       15.       14.       13.       13.       12.       12.       11.       11.

                          PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                CFS      1156.      939.      459.      162.        46757.
                CMS        33.       27.       13.        5.         1324.
             INCHES                 5.67     11.10     11.77         11.77
                 MM               144.09    281.92    298.91        298.91
              AC-FT                 466.      911.      966.          966.
         THOUS CU M                 574.     1124.     1192.         1192.


 **********          **********          **********          **********          **********

                                   HYDROGRAPH ROUTING
```

SHEET 21 OF 28

ROUTE THROUGH CANONSBURG NO. 2

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM2	1	0	0	0	1	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1031.	-1

STAGE	1030.80	1031.80	1033.00	1034.00	1035.00	1035.30	1035.40	1035.60	1036.10	1036.40
FLOW	0.00	100.00	300.00	590.00	890.00	1050.00	1145.00	1500.00	2740.00	3700.00
CAPACITY=	0.	20.	70.	155.	275.	435.	660.	827.	960.	1240.
ELEVATION=	995.	1000.	1005.	1010.	1015.	1020.	1025.	1030.	1034.	1040.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
1030.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1035.0	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	HSEL	FAILEL
28.	1.00	998.50	.50	1030.80	1050.00

STATION DAM2, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	2.	3.	4.	5.	6.	8.	9.	11.
13.	14.	15.	17.	18.	19.	20.	21.	21.	22.
23.	23.	23.	24.	24.	24.	24.	24.	24.	24.
24.	24.	24.	24.	24.	25.	25.	25.	26.	26.
27.	28.	28.	29.	30.	31.	32.	33.	34.	35.
36.	38.	39.	40.	42.	44.	46.	49.	52.	55.
59.	63.	68.	73.	79.	85.	91.	97.	106.	117.
127.	138.	148.	157.	167.	176.	186.	196.	208.	221.
236.	255.	276.	300.	345.	393.	447.	505.	567.	630.
708.	806.	935.	1210.	1707.	2009.	2178.	2284.	2338.	2359.
2360.	2346.	2316.	2273.	2217.	2153.	2088.	2021.	1950.	1877.
1800.	1723.	1657.	1594.	1534.	1483.	1437.	1388.	1339.	1291.
1244.	1199.	1156.	1127.	1098.	1068.	1043.	1023.	1000.	974.
947.	918.	889.	871.	853.	835.	816.	797.	778.	758.
738.	717.	697.	675.	654.	633.	612.	592.	567.	543.
521.	500.	480.	461.	443.	426.	409.	393.	378.	363.
349.	335.	322.	309.	298.	291.	284.	277.	269.	262.

SHEET 22 OF 28

SHEET 23 OF 28

```
  255.      248.      241.      234.      227.      220.      213.      206.      199.      192.
  186.      179.      173.      167.      162.      157.      152.      148.      144.      140.
  136.      133.      130.      128.      125.      123.      121.      118.      116.      114.
  111.      109.      107.      104.      102.      100.       98.       96.       95.       93.
   91.       89.       87.       86.       84.       82.       80.       78.       76.       74.
   72.       70.       68.       66.       64.       62.       60.       59.       57.       55.

                                      STORAGE
  854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
  854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
  854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
  854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
  854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
  854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
  854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
  854.      854.      854.      854.      855.      855.      856.      856.      857.      857.
  858.      858.      859.      859.      860.      860.      860.      860.      861.      861.
  861.      861.      861.      861.      862.      862.      862.      862.      862.      862.
  862.      862.      862.      862.      862.      862.      862.      862.      862.      862.
  863.      863.      863.      863.      864.      864.      864.      865.      865.      865.
  866.      866.      867.      867.      868.      868.      869.      870.      871.      872.
  873.      875.      876.      878.      880.      882.      884.      886.      888.      890.
  892.      894.      896.      898.      900.      902.      904.      906.      908.      911.
  914.      918.      922.      927.      932.      937.      944.      950.      957.      966.
  978.      994.     1011.     1027.     1039.     1044.     1047.     1049.     1050.     1051.
 1051.     1051.     1050.     1049.     1048.     1047.     1046.     1044.     1043.     1042.
 1040.     1039.     1038.     1036.     1035.     1034.     1033.     1032.     1030.     1029.
 1028.     1027.     1026.     1024.     1023.     1022.     1020.     1018.     1016.     1014.
 1012.     1009.     1006.     1004.     1001.      998.      995.      992.      989.      986.
  983.      980.      977.      973.      970.      967.      963.      960.      957.      955.
  952.      950.      947.      945.      943.      941.      939.      937.      936.      934.
  932.      931.      929.      928.      926.      925.      924.      922.      921.      919.
  918.      916.      915.      914.      912.      911.      909.      908.      907.      905.
  904.      903.      901.      900.      899.      898.      897.      896.      896.      895.
  894.      893.      893.      892.      892.      891.      891.      891.      890.      890.
  889.      889.      888.      888.      887.      887.      886.      886.      885.      885.
  884.      883.      883.      882.      881.      881.      880.      879.      879.      878.
  877.      877.      876.      876.      875.      874.      874.      873.      873.      872.

                                       STAGE
 1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
 1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
 1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
 1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
 1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
 1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
 1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
 1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.9    1030.9    1030.9    1030.9
 1030.9    1030.9    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0
 1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0
 1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.0    1031.1    1031.1    1031.1
 1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.2
 1031.2    1031.2    1031.2    1031.2    1031.2    1031.2    1031.3    1031.3    1031.3    1031.4
 1031.4    1031.4    1031.5    1031.5    1031.6    1031.6    1031.7    1031.8    1031.8    1031.9
 1032.0    1032.0    1032.1    1032.1    1032.2    1032.3    1032.3    1032.4    1032.4    1032.5
 1032.6    1032.7    1032.9    1033.0    1033.2    1033.5    1033.5    1033.7    1033.9    1034.1
 1034.4    1034.7    1035.1    1035.4    1035.7    1035.8    1035.9    1035.9    1035.9    1035.9
 1035.9    1035.9    1035.9    1035.9    1035.9    1035.9    1035.8    1035.8    1035.8    1035.8
 1035.7    1035.7    1035.7    1035.6    1035.6    1035.6    1035.6    1035.5    1035.5    1035.5
 1035.5    1035.4    1035.4    1035.4    1035.4    1035.3    1035.3    1035.2    1035.2    1035.2
 1035.1    1035.1    1035.0    1034.9    1034.9    1034.8    1034.8    1034.7    1034.6    1034.6
 1034.5    1034.4    1034.4    1034.3    1034.2    1034.1    1034.1    1034.0    1033.9    1033.8
```

SHEET 24 OF 28

```
    1033.7   1033.6   1033.6   1033.5   1033.4   1033.4   1033.3   1033.3   1033.2
    1033.1   1033.1   1033.0   1033.0   1032.9   1032.9   1032.9   1032.8   1032.8
    1032.7   1032.6   1032.6   1032.6   1032.5   1032.5   1032.4   1032.4   1032.4
    1032.3   1032.2   1032.2   1032.2   1032.1   1032.1   1032.1   1032.1   1032.0
    1032.0   1032.0   1032.0   1032.0   1031.9   1031.9   1031.9   1031.9   1031.9
    1031.9   1031.8   1031.8   1031.8   1031.8   1031.8   1031.8   1031.7   1031.7
    1031.7   1031.7   1031.7   1031.6   1031.6   1031.6   1031.6   1031.6   1031.5
    1031.5   1031.5   1031.5   1031.4   1031.4   1031.4   1031.4   1031.4   1031.4

[illegible]   2360. AT TIME  42.75 HOURS

                    PEAK   6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
          CFS      2360.    1959.      958.      354.        102085.
          CMS        67.      55.       27.       10.          2891.
       INCHES               11.83     23.14     25.69          25.69
           MM              300.49    587.85    652.61         652.61
        AC-FT                971.     1900.     2109.          2109.
   THOUS CU M               1198.     2343.     2602.          2602.


                         STATION   DAM2, PLAN 1, RATIO 2

                      END-OF-PERIOD HYDROGRAPH ORDINATES

                                   OUTFLOW
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        1.        1.        2.        3.        4.        5.        7.        9.
    11.       13.       16.       18.       21.       25.       28.       32.       36.       42.
    48.       55.       63.       72.       82.       94.      110.      132.      155.      180.
   209.      242.      278.      331.      404.      479.      554.      622.      682.      740.
   791.      835.      871.      906.      940.      962.      972.      974.      968.      956.
   939.      919.      896.      879.      864.      848.      832.      815.      798.      780.
   762.      743.      724.      705.      685.      665.      645.      626.      607.      588.
   564.      542.      521.      501.      482.      464.      446.      429.      413.      398.
   383.      368.      354.      341.      328.      315.      303.      295.      288.      281.
   274.      267.      260.      253.      246.      239.      232.      225.      218.      211.
   204.      197.      190.      183.      177.      170.      164.      157.      151.      145.
   140.      134.      129.      124.      119.      114.      110.      105.      101.       98.
    96.       93.       91.       88.       86.       84.       82.       80.       78.       76.
    74.       72.       70.       69.       67.       66.       64.       63.       61.       60.
    59.       57.       56.       54.       53.       52.       50.       49.       48.       46.
    45.       44.       43.       41.       40.       39.       38.       37.       36.       34.
    33.       32.       31.       30.       29.       28.       27.       26.       25.       25.

                                   STORAGE
   854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
   854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
   854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
```

SHEET 25 OF 26

```
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      854.      854.      854.      854.
     854.      854.      854.      854.      854.      854.      855.      855.      856.      856.
     857.      858.      859.      860.      861.      862.      863.      864.      866.      867.
     869.      872.      874.      877.      881.      885.      889.      893.      898.      903.
     909.      915.      922.      930.      939.      947.      956.      965.      974.      983.
     991.      998.     1004.     1008.     1011.     1013.     1014.     1014.     1013.     1012.
    1011.     1009.     1007.     1005.     1003.     1000.      998.      995.      992.      990.
     987.      984.      981.      978.      975.      972.      969.      966.      963.      960.
     957.      954.      952.      950.      948.      945.      944.      942.      940.      938.
     936.      935.      933.      931.      930.      928.      927.      926.      924.      923.
     922.      920.      919.      917.      916.      915.      913.      912.      910.      909.
     908.      906.      905.      903.      902.      901.      900.      898.      897.      896.
     895.      894.      893.      892.      891.      890.      889.      888.      887.      886.
     885.      885.      884.      883.      882.      881.      881.      880.      879.      879.
     878.      878.      877.      877.      876.      875.      875.      875.      874.      874.
     873.      873.      872.      872.      871.      871.      870.      870.      869.      869.
     869.      868.      868.      867.      867.      867.      866.      866.      865.      865.
     865.      864.      864.      864.      863.      863.      863.      862.      862.      862.

                                               STAGE
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8
    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.8    1030.9    1030.9    1030.9
    1030.9    1030.9    1031.0    1031.0    1031.0    1031.0    1031.1    1031.1    1031.2    1031.2
    1031.3    1031.3    1031.4    1031.5    1031.6    1031.7    1031.9    1032.0    1032.1    1032.3
    1032.5    1032.6    1032.9    1033.1    1033.4    1033.6    1033.9    1034.1    1034.3    1034.5
    1034.7    1034.8    1034.9    1035.0    1035.1    1035.1    1035.2    1035.2    1035.1    1035.1
    1035.1    1035.1    1035.0    1035.0    1034.9    1034.9    1034.8    1034.8    1034.7    1034.6
    1034.6    1034.5    1034.4    1034.4    1034.3    1034.3    1034.2    1034.1    1034.1    1034.0
    1033.9    1033.8    1033.8    1033.7    1033.6    1033.6    1033.5    1033.4    1033.4    1033.3
    1033.3    1033.2    1033.2    1033.1    1033.1    1033.1    1033.0    1033.0    1032.9    1032.9
    1032.8    1032.8    1032.8    1032.7    1032.7    1032.6    1032.6    1032.6    1032.5    1032.5
    1032.4    1032.4    1032.3    1032.3    1032.3    1032.2    1032.2    1032.1    1032.1    1032.1
    1032.0    1032.0    1032.0    1031.9    1031.9    1031.9    1031.9    1031.8    1031.8    1031.8
    1031.8    1031.7    1031.7    1031.7    1031.7    1031.6    1031.6    1031.6    1031.6    1031.6
    1031.5    1031.5    1031.5    1031.5    1031.5    1031.5    1031.4    1031.4    1031.4    1031.4
    1031.4    1031.4    1031.4    1031.3    1031.3    1031.3    1031.3    1031.3    1031.3    1031.3
    1031.3    1031.2    1031.2    1031.2    1031.2    1031.2    1031.2    1031.2    1031.2    1031.1
    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.1    1031.0

 PEAK OUTFLOW IS      974. AT TIME  44.50 HOURS
```

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	974.	862.	450.	161.	46367.
CMS	28.	24.	13.	5.	1313.
INCHES		5.21	10.86	11.67	11.67
MM		132.31	275.88	296.42	296.42
AC-FT		428.	892.	958.	958.
THOUS CU M		527.	1100.	1182.	1182.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

TAILWATER STAGES AT CANONSBURG NO. 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	1	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

STORAGE	0.00	.10	.30							
OUTFLOW	0.00	7000.00	30000.00							
STAGE	996.00	996.50	997.00	997.50	997.70	998.00	998.20	998.50	999.00	1005.00
	1011.40	1016.10								
FLOW	0.00	55.00	145.00	300.00	400.00	610.00	790.00	1090.00	1680.00	10000.00
	20000.00	30000.00								

STATION 4, PLAN 1, RTIO 1

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	2.	3.	4.	5.	6.	8.	9.	11.
13.	14.	15.	17.	18.	19.	20.	21.	21.	22.
23.	23.	23.	24.	24.	24.	24.	24.	24.	24.
24.	24.	24.	24.	24.	25.	25.	25.	26.	26.
27.	28.	28.	29.	30.	31.	32.	33.	34.	35.
36.	38.	39.	40.	42.	44.	46.	49.	52.	55.
59.	63.	68.	73.	79.	85.	91.	97.	106.	117.
127.	138.	148.	157.	167.	176.	186.	196.	208.	221.
236.	255.	276.	300.	345.	393.	447.	505.	567.	630.
708.	806.	935.	1210.	1707.	2009.	2178.	2285.	2338.	2360.
2360.	2346.	2316.	2273.	2217.	2153.	2087.	2021.	1950.	1878.
1799.	1724.	1657.	1594.	1538.	1483.	1437.	1388.	1339.	1291.
1244.	1200.	1156.	1127.	1098.	1068.	1045.	1023.	1000.	974.
946.	918.	889.	871.	853.	835.	818.	798.	778.	758.

SHEET 26 OF 28

SUMMARY OF DAM SAFETY ANALYSIS

UPPER BASIN - CANONSBURG DAM NO. 2

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1030.80	1023.70	1035.10
STORAGE	35.	0.	84.
OUTFLOW	0.	0.	440.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1036.48	1.38	106.	1592.	13.25	42.50	0.00
.50	1035.93	.83	97.	777.	6.75	42.50	0.00

SHEET 27 OF 28

SUMMARY OF DAM SAFETY ANALYSIS

CANONCITO DAM NO. 2
PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1030.00	1030.00	1035.00
STORAGE	854.	854.	1007.
OUTFLOW	0.	0.	890.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1035.95	.95	1051.	2360.	10.00	42.75	0.00
.50	1035.16	.16	1014.	974.	2.50	44.50	0.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	2360.	999.6	42.75
.50	974.	998.8	44.50

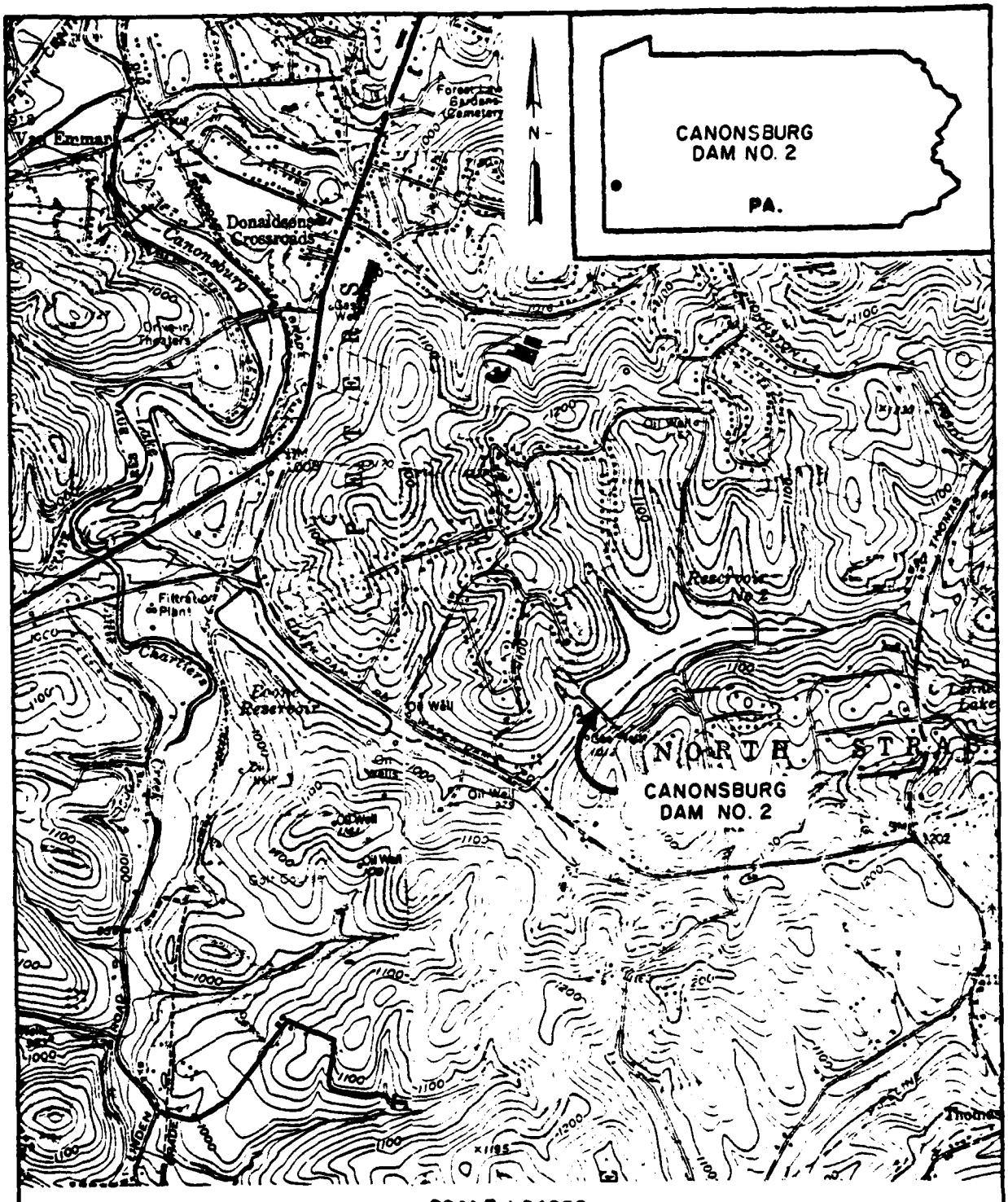
SHEET 28 OF 29

APPENDIX E

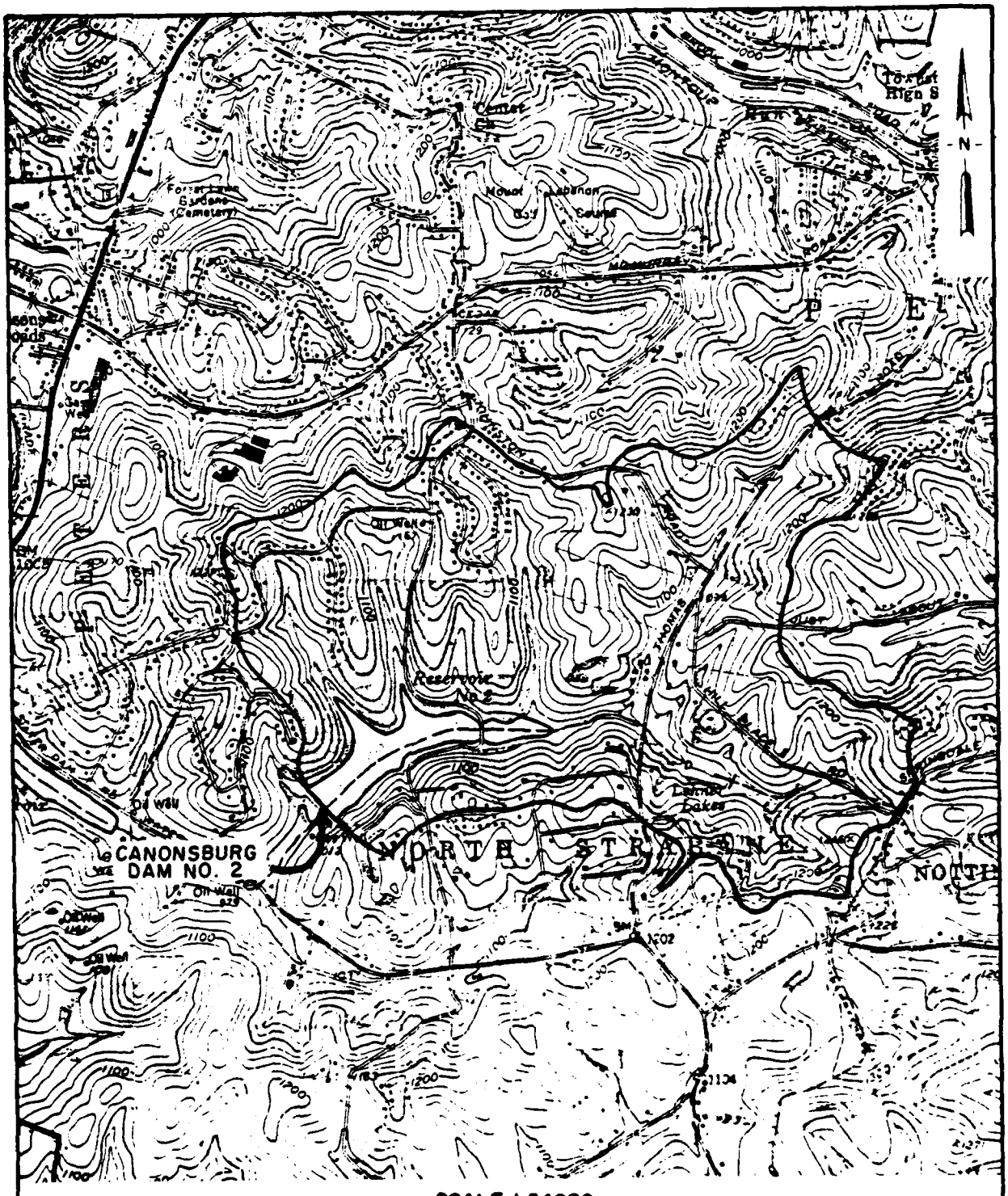
PLATES

CONTENTS

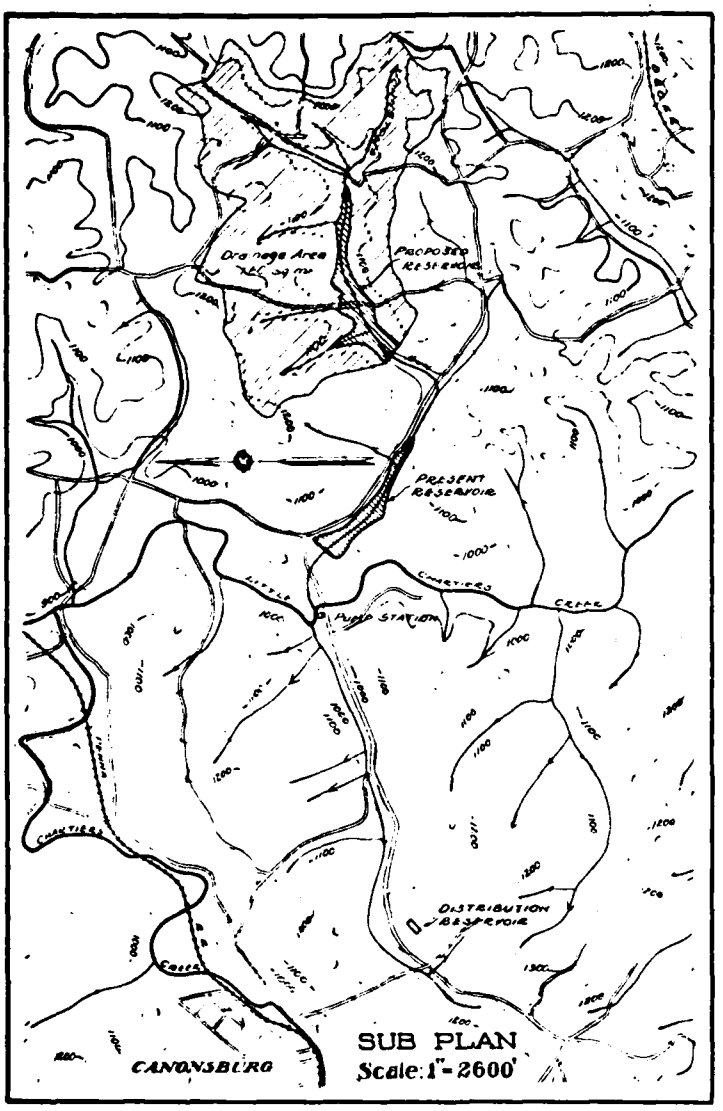
Note: Plates 3-6 are the original design drawings dated May 1931. Plates 7-12 are drawings provided by Burgess and Niple, Limited showing the proposed slope modification (1979).

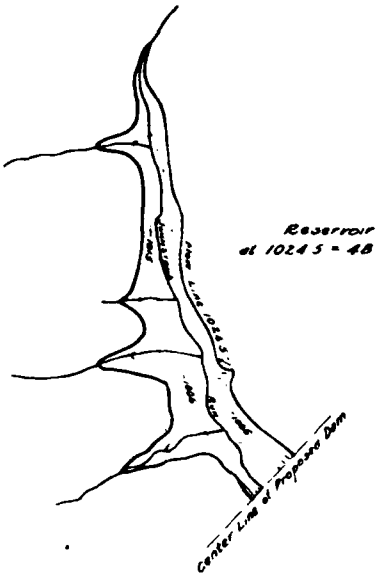


CANONSBURG DAM NO. 2
PLATE 1 - LOCATION MAP

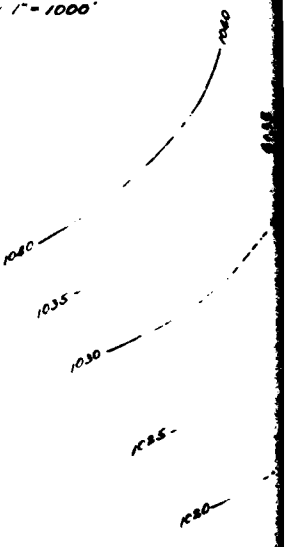


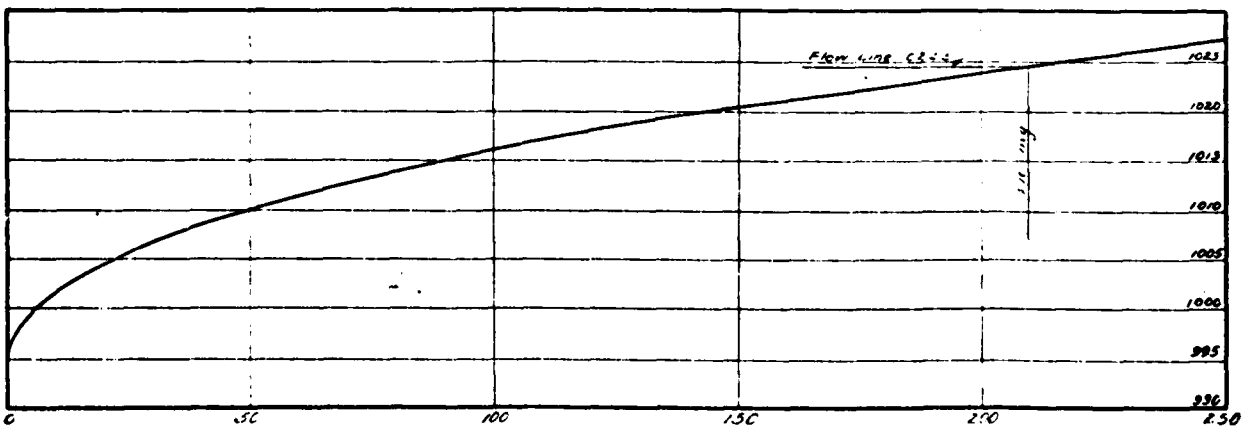
CANONSBURG DAM NO. 2
PLATE 2 - WATERSHED MAP



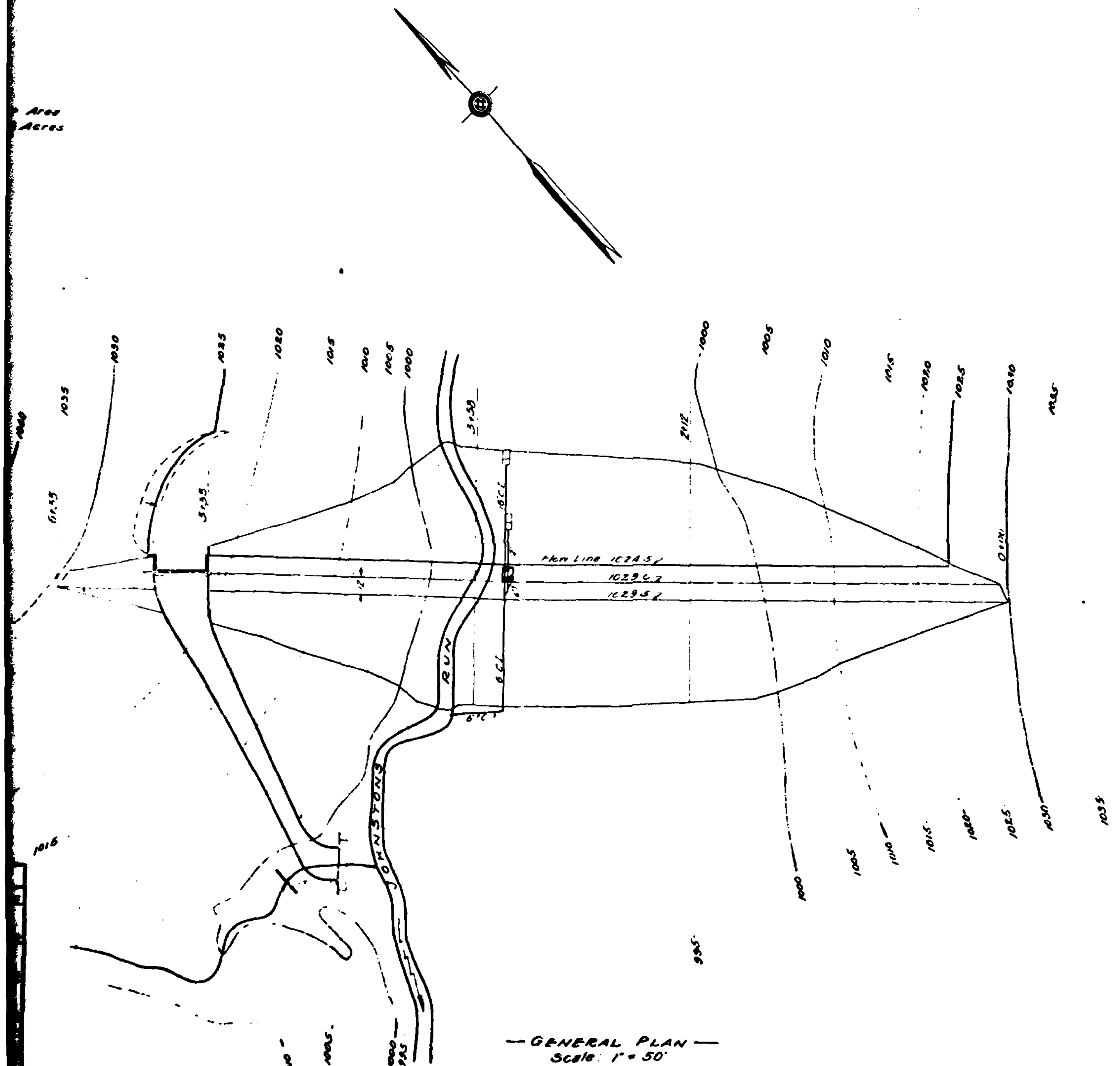


— PLAN OF RESERVOIR —
Scale: 1" = 1000'





Capacity - Millions of Gallons
— CAPACITY CURVE —

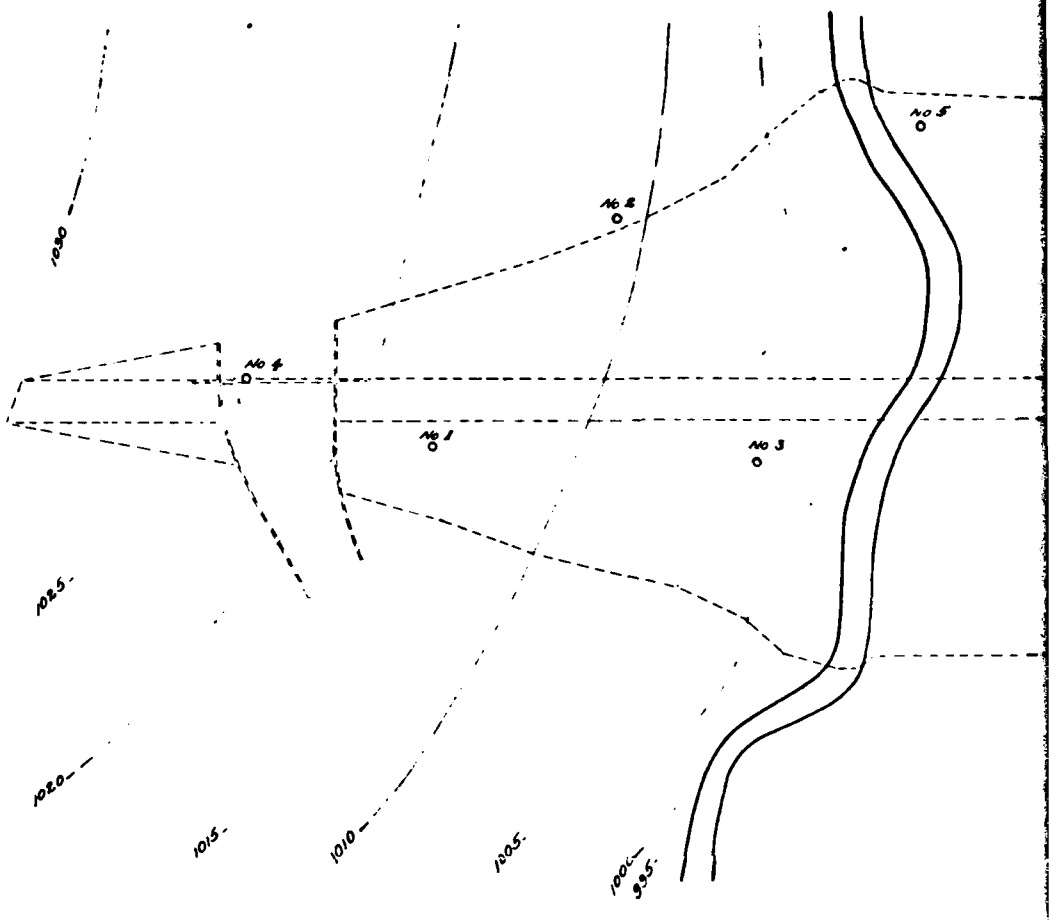


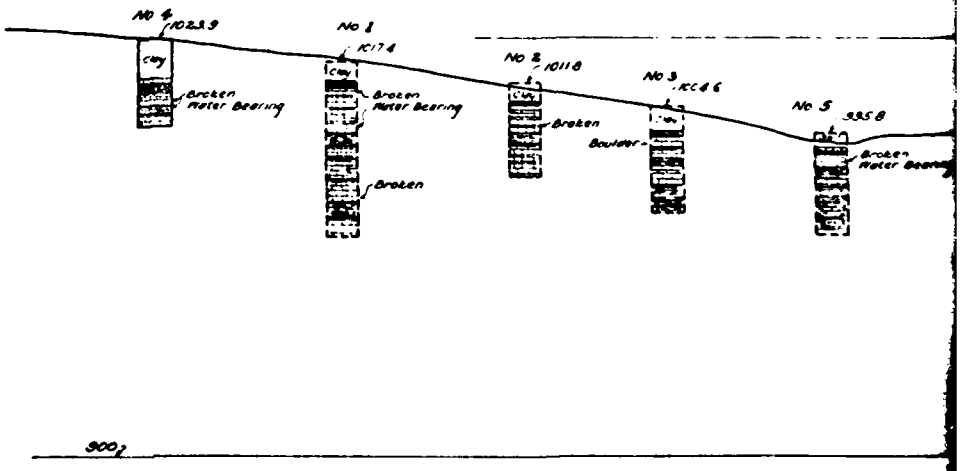
— GENERAL PLAN —
Scale: 1" = 50'

PLATE 3

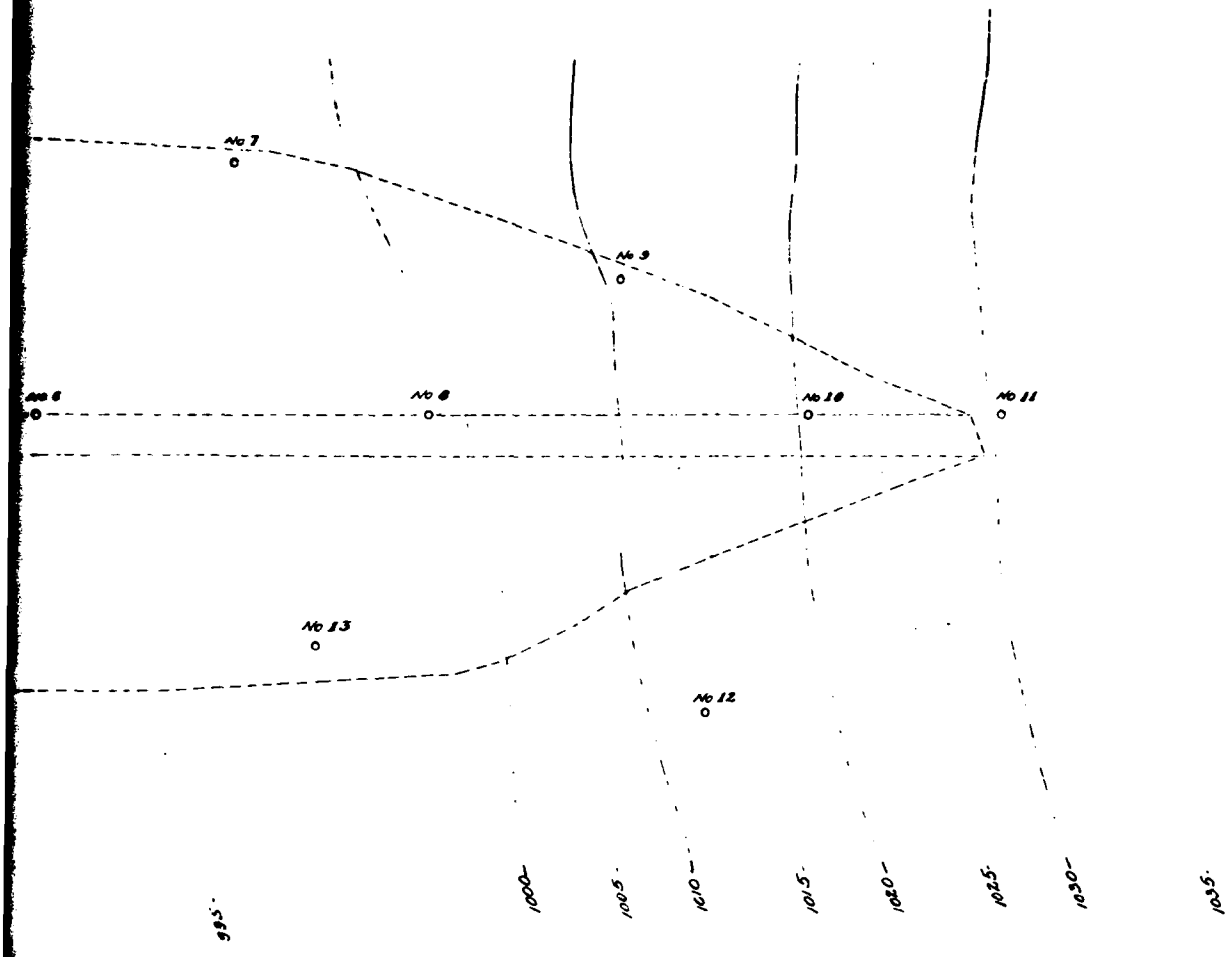
CITIZENS WATER CO.
Washington, Pa
CANONSBURG DIVISION
STORAGE RESERVOIR
Peters and N Strabane Twps, Wash Co, Pa
Scale - as indicated May 1931.
Sheet ① of 4 D C Morrow, Eng'r

2

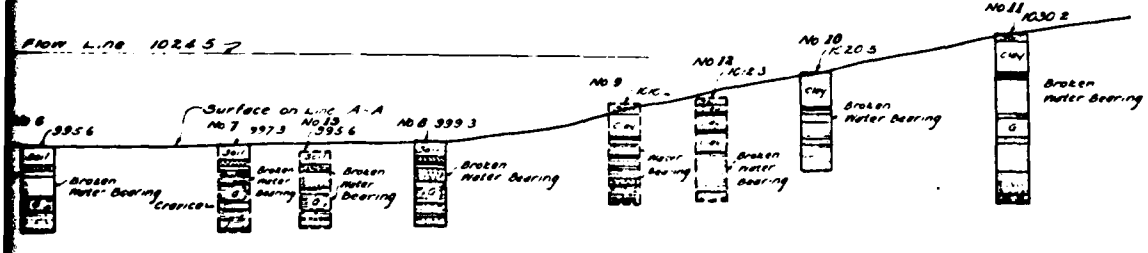

No 5
No 2
No 4
No 1
No 3
1030
1025
1020
1015
1010
1005
100
995


No 4
102.39
No 1
101.74
No 2
101.18
No 3
100.46
No 5
99.58
Broken
Water Bearing
Broken
Broken
Boulder
Broken
Water Bearing

900



PLAN
Scale 1"=30'



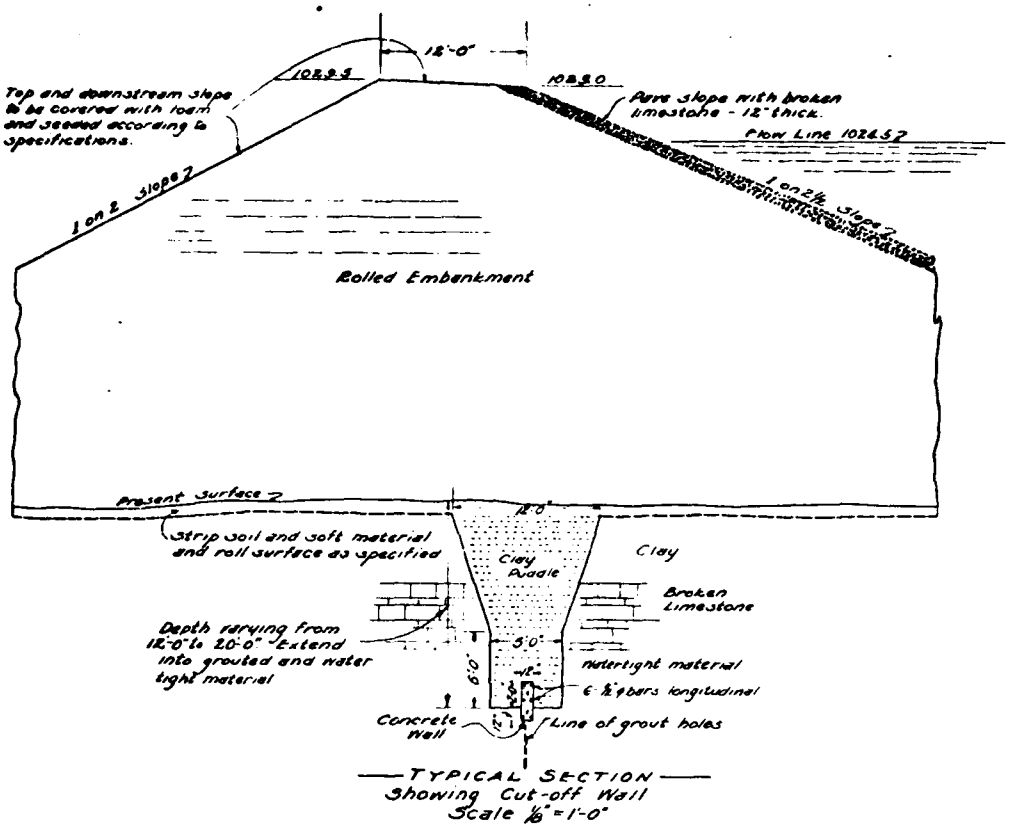
Datum 900.00 - PSHD

SECTION
Scale:- Hor - 1"=30'
Vert - 1"=30'

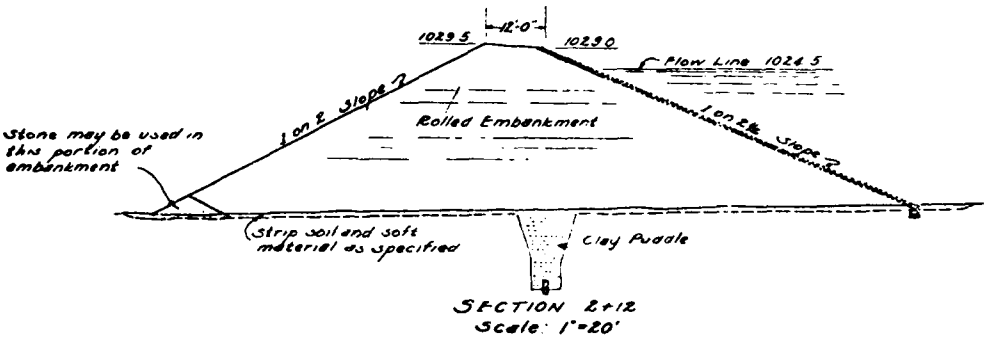
PLATE 4

CITIZENS WATER CO
Washington, Pa
CANONSBURG DIVISION
STORAGE RESERVOIR
Peters & N Strabane Twps, Wash Co, Pa
Scale - as indicated May 1931
Sheet (2) of 4 D C Morrow, Engr

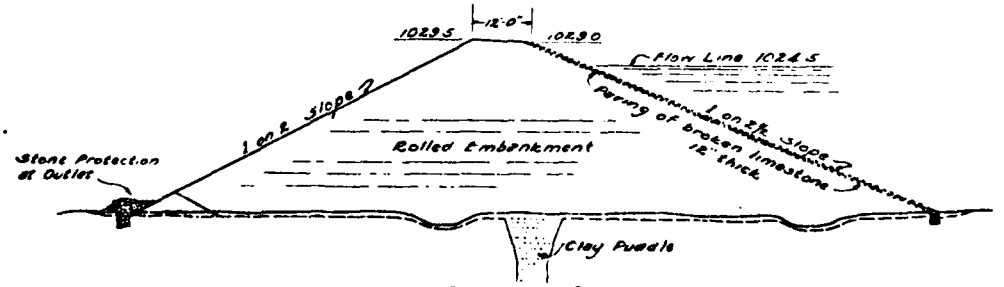
2



TYPICAL SECTION
Showing Cut-off Wall
Scale ⅛" = 1'-0"



SECTION 2+12
Scale: 1" = 20'

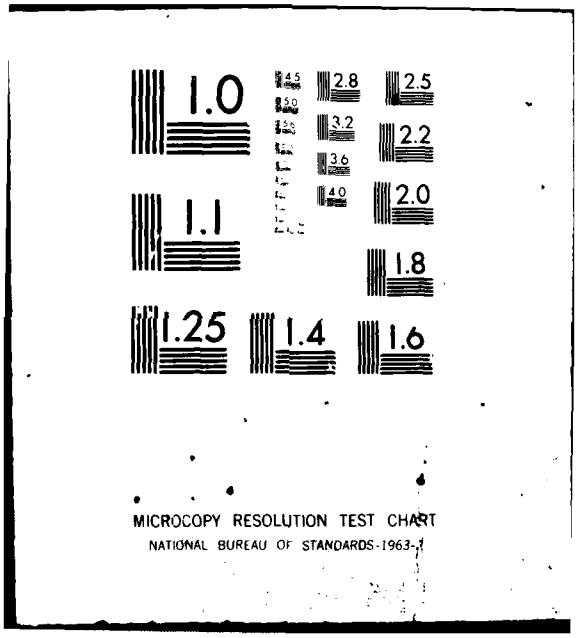


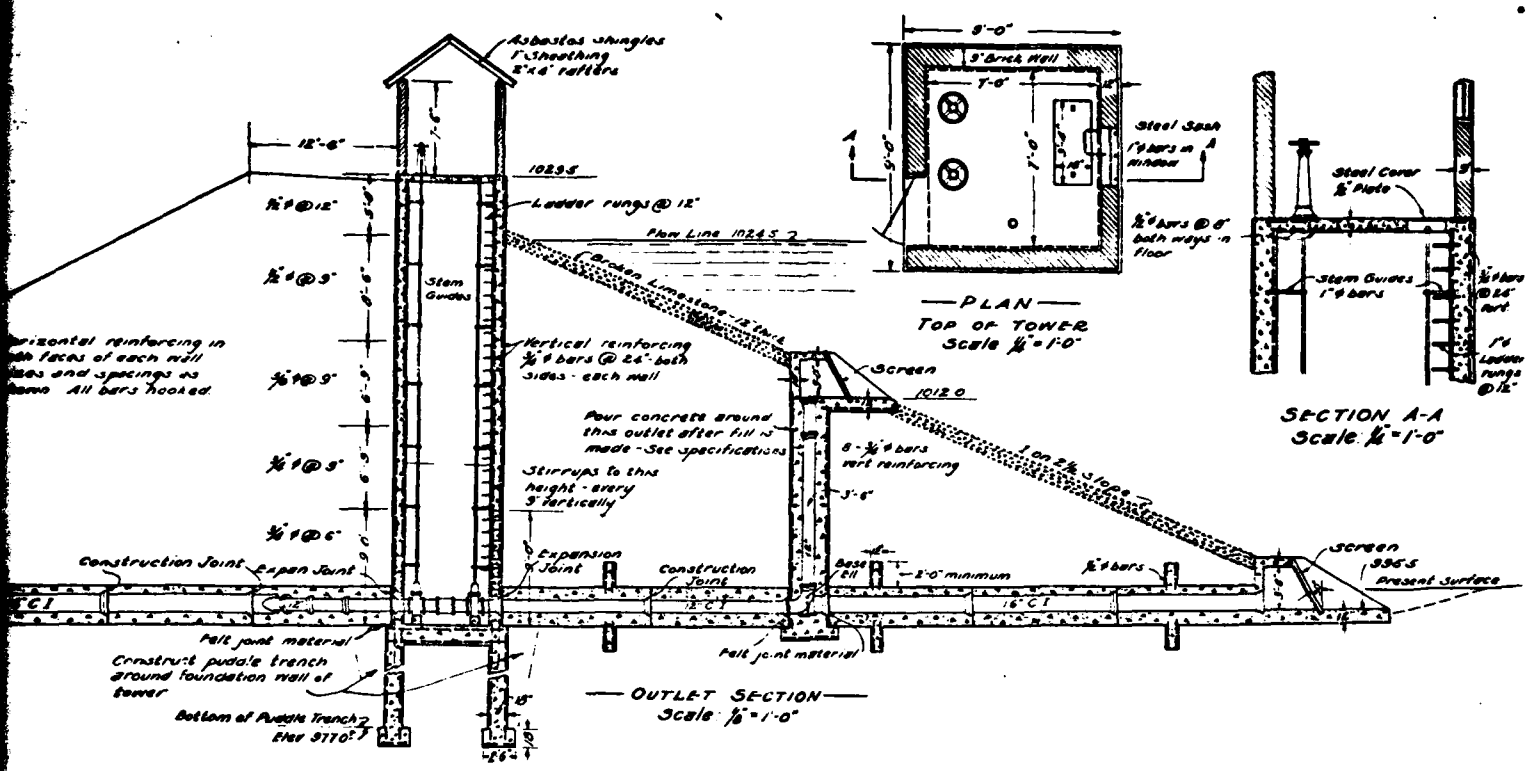
SECTION 3+58
MAXIMUM SECTION
Scale: 1" = 20'

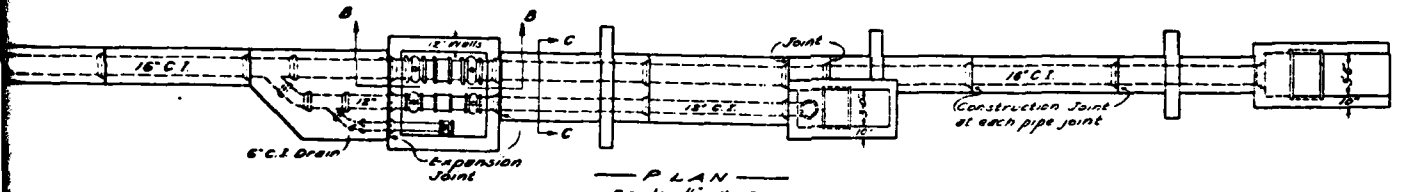
AD-A083 386 BAKER (MICHAEL) JR INC BEAVER PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. CANONSBURG DAM NUMBER 2 (JOHNS--ETC(U)
FEB 80 J A DZIUBEK DACW31-80-C-0025

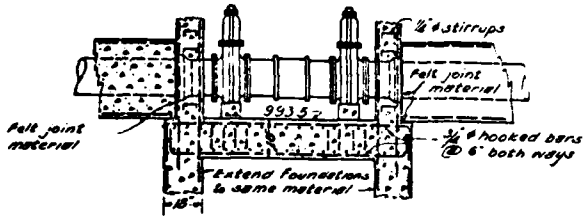
UNCLASSIFIED NL

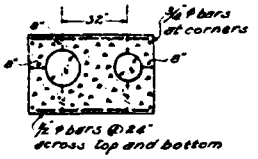
2 OF 2
AD
A083386

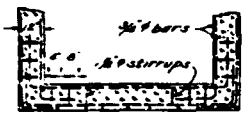

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A











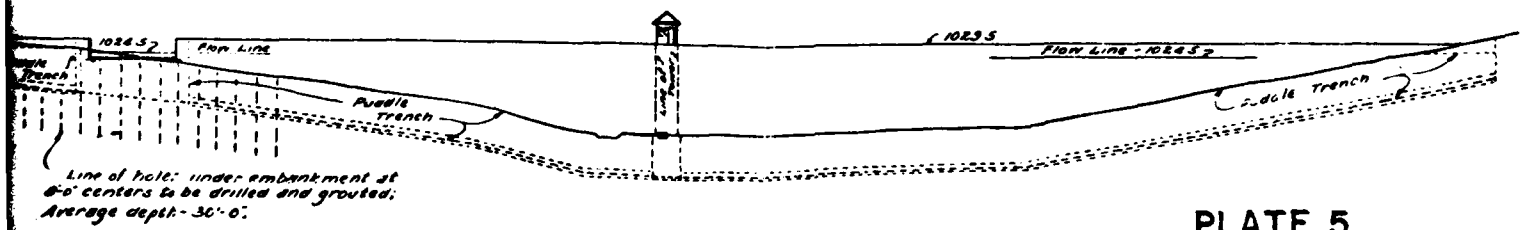
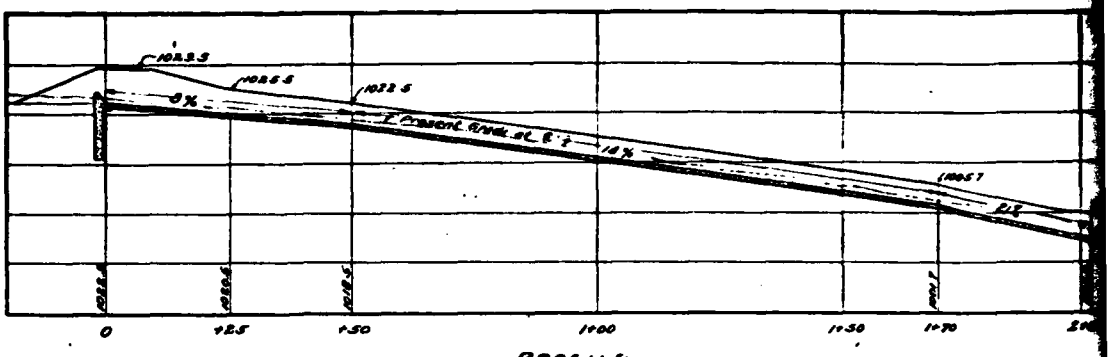
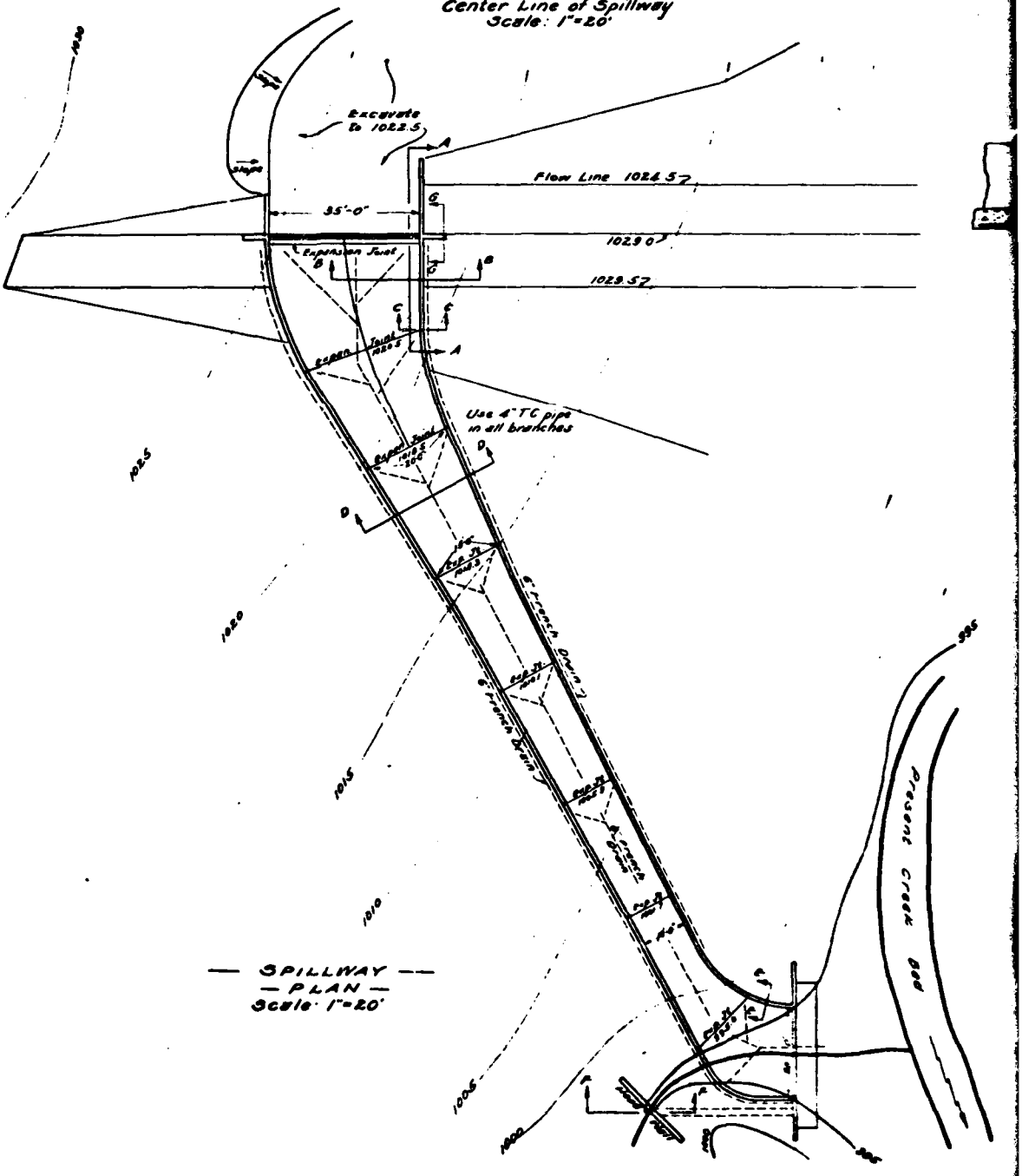


PLATE 5

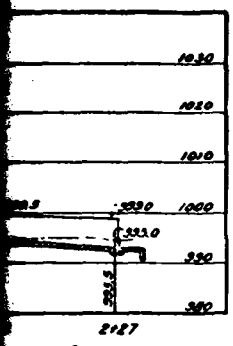
CITIZENS WATER CO.
Washington, Pa
CANONSBURG DIVISION
STORAGE RESERVOIR
Peters and N. Strabane Twps, Wash Co, Pa
Scale - as indicated May 1931.
Sheet 3 of 4 D.C. Morrow, Engr

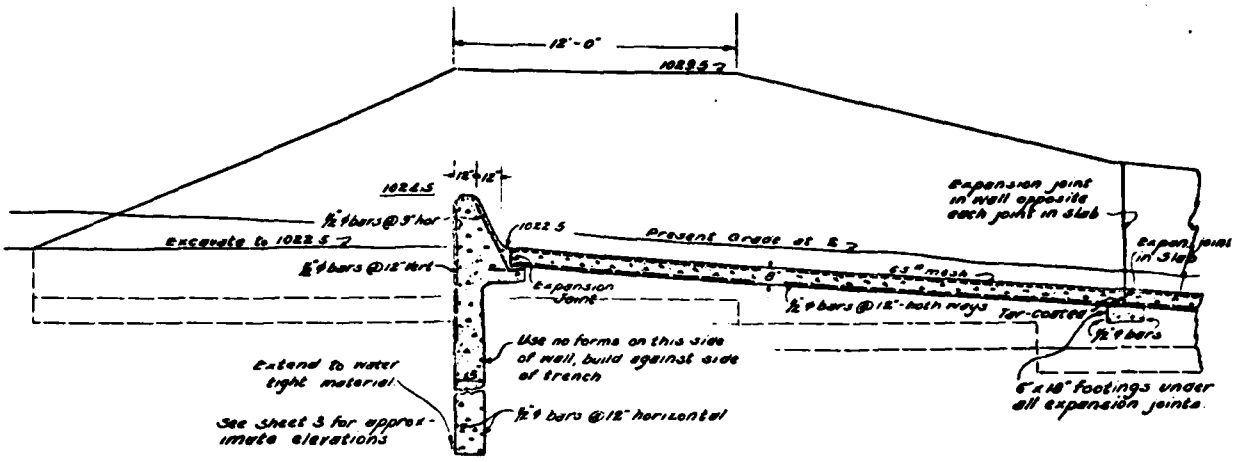


— PROFILE —
Center Line of Spillway
Scale: 1"=20'

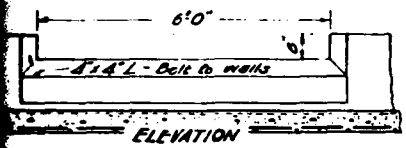


— SPILLWAY —
— PLAN —
Scale: 1"=20'

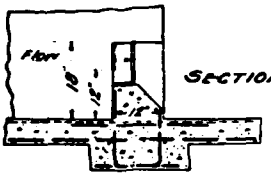




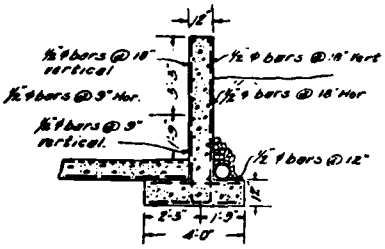
SECTION A-A
Scale: 1/4"-1'-0"



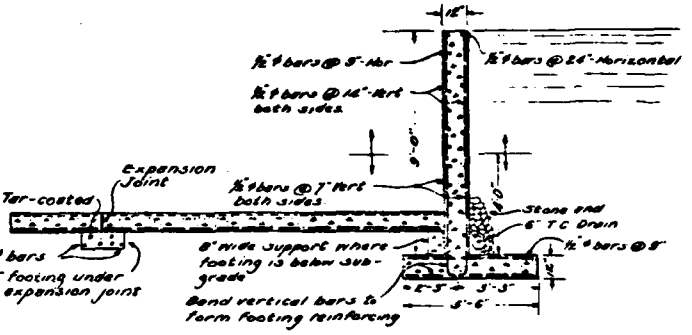
ELEVATION



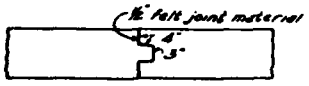
STILLING POOL OUTLET
Scale: 1/2"=1'-0"



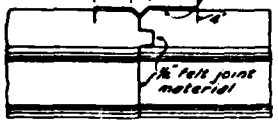
SECTION C-C
(SECTION E-E similar)
Scale: 1/4"=1'-0"
(Use similar wall section for lower wing walls.)



SECTION B-B
Scale 1/4"=1'-0"
MAXIMUM SECTION

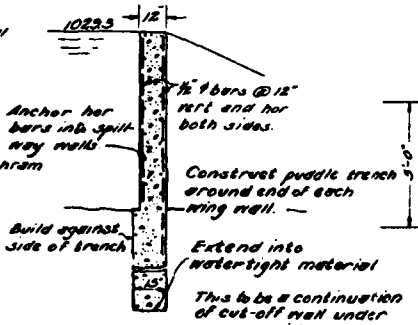


— WALL JOINT —

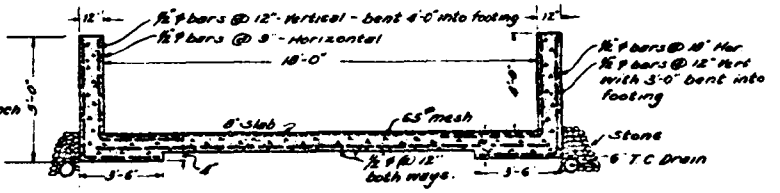


— WEIR JOINT —

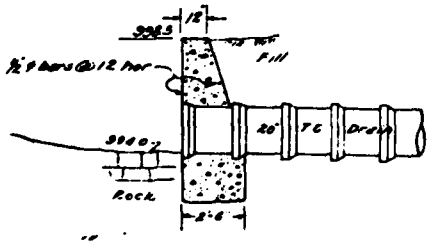
EXPANSION JOINT DETAILS
Scale: 1/2"=1'-0"



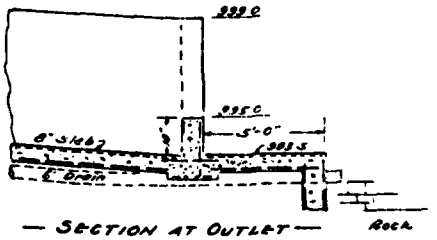
SECTION G-G
SOUTH WING WALL
Scale: 1/4"=1'-0"



SECTION D-D
Scale: 1/4"=1'-0"
TYPICAL SECTION



SECTION F-F
Scale: 1/2"=1'-0"

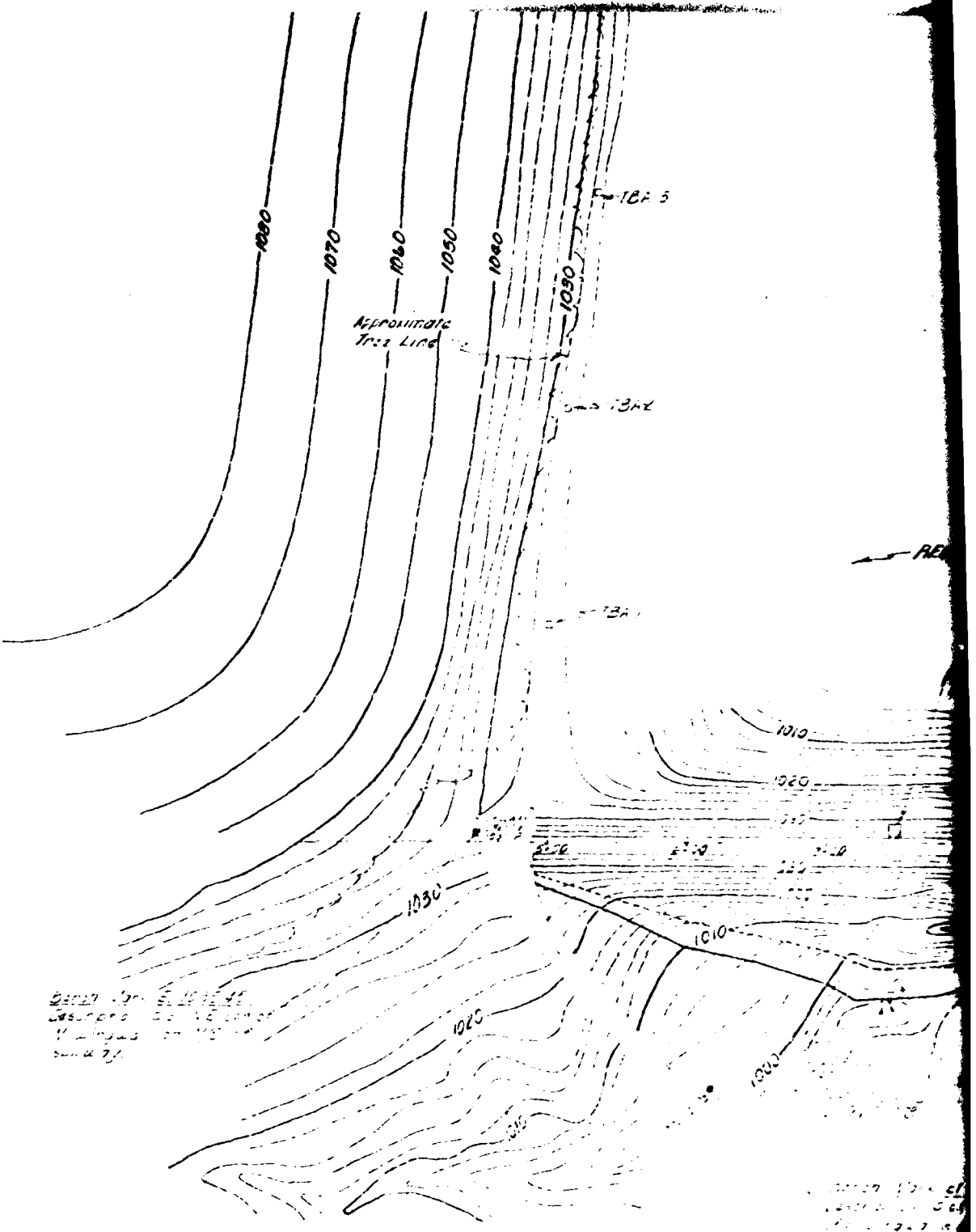


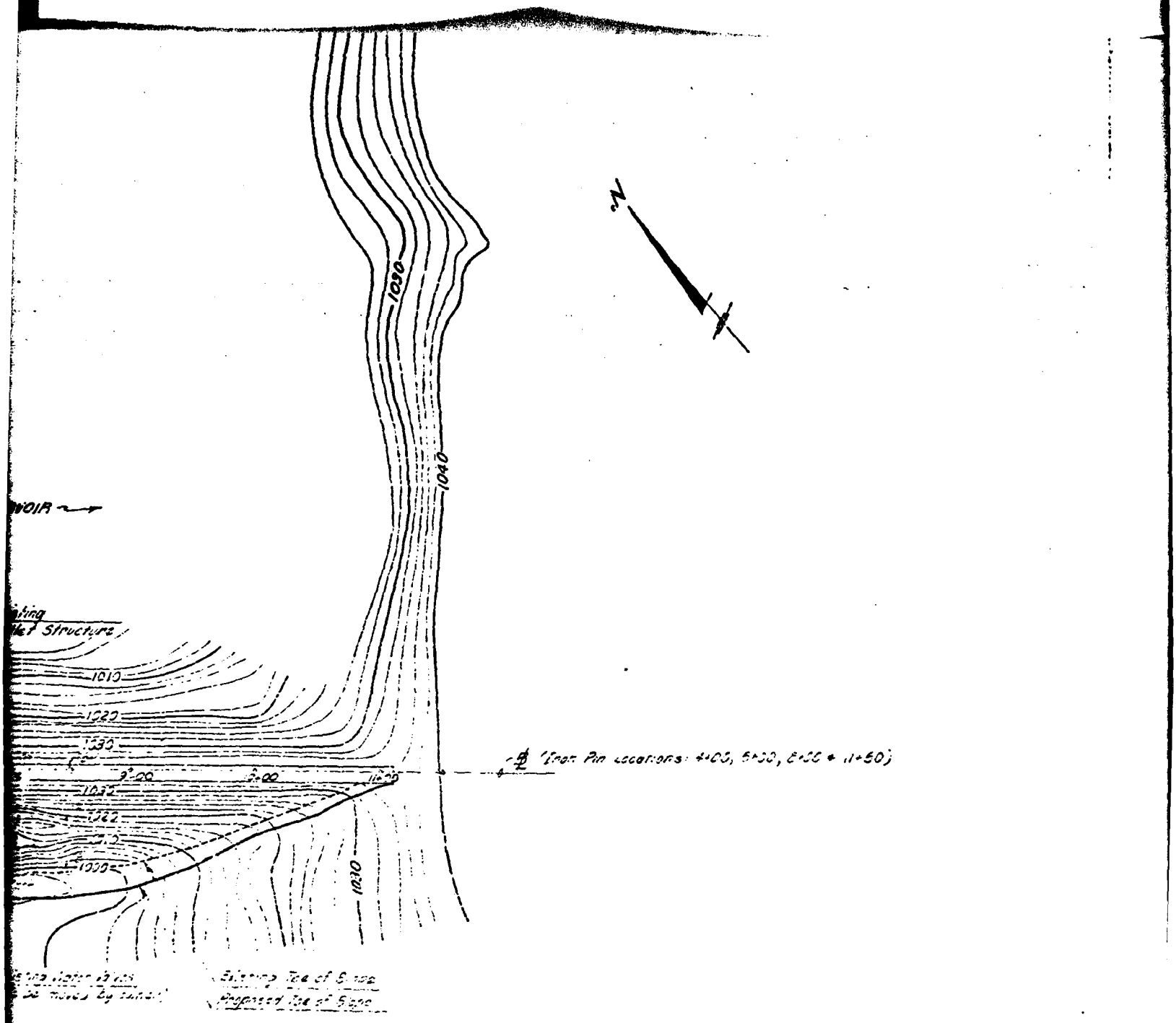
— SECTION AT OUTLET —
Scale: 1/2"=1'-0"
(See detail of weir)

PLATE 6

CITIZENS WATER CO.
Washington, Pa
CANONSBURG DIVISION
STORAGE RESERVOIR
Peters and N Strabane Twps, Wash Co, Pa
Scale - as indicated May 1931
Sheet (4) of 4 D C Morrow, Engr

2


1090
1070
1060
1050
1040
1090
Approximate
Trace Line
1030
1020
1010
1010
1020
1030
1020
1010

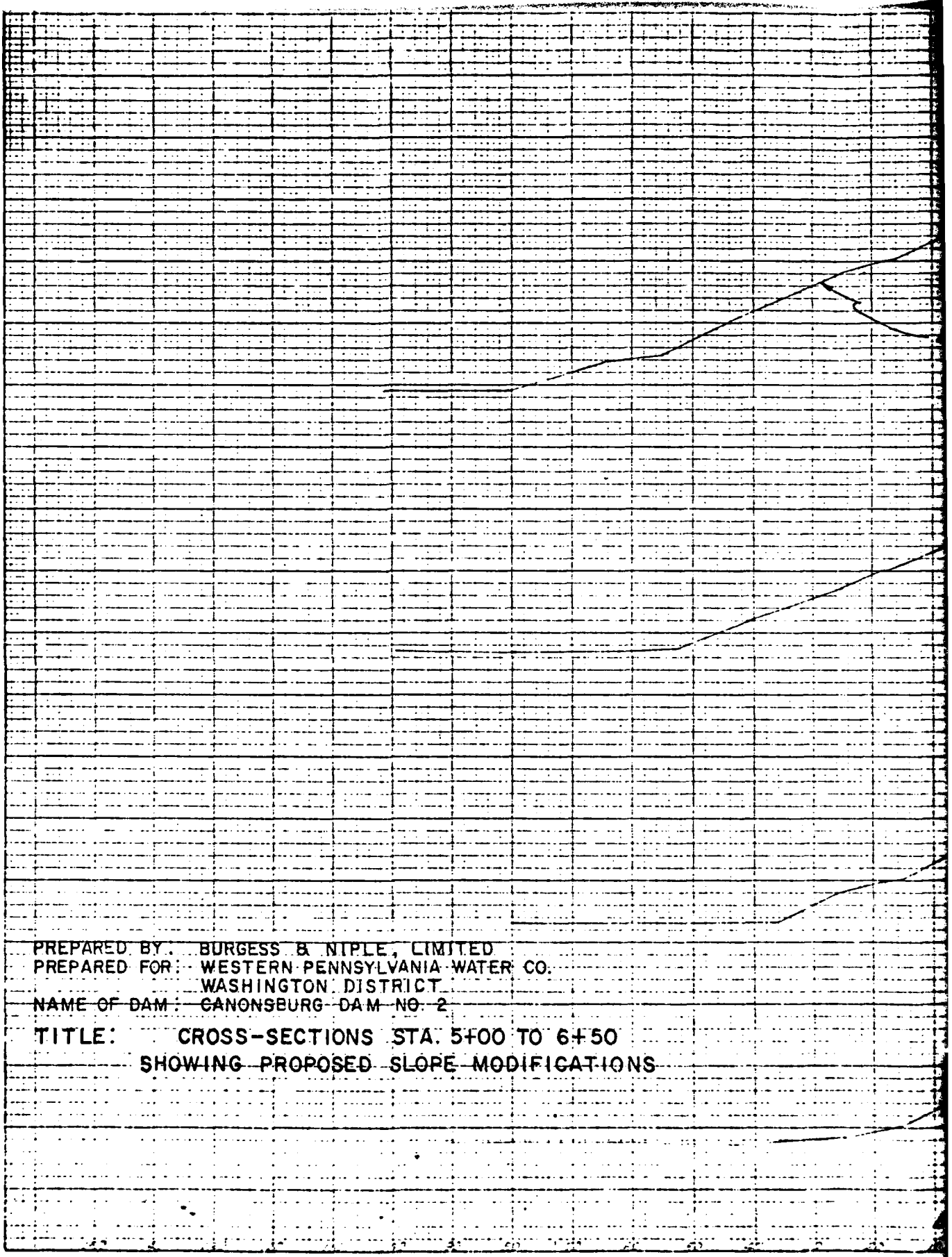


PREPARED BY : BURGESS & NIPLE, LIMITED
PREPARED FOR: WESTERN PENNSYLVANIA WATER CO.
WASHINGTON DISTRICT
NAME OF DAM : CANONSBURG DAM NO. 2

TITLE: PLAN OF DAM SHOWING
PROPOSED SLOPE MODIFICATIONS

PLATE 7 2

BURG DAM No. 2 WESTERN PENNSYLVANIA WATER COMPANY WASHINGTON DISTRICT SHEET NO 112



PREPARED BY: BURGESS & NIPLE, LIMITED
PREPARED FOR: WESTERN PENNSYLVANIA WATER CO.
WASHINGTON DISTRICT
NAME OF DAM: CANONSBURG DAM NO. 2

TITLE: CROSS-SECTIONS STA. 5+00 TO 6+50
SHOWING PROPOSED SLOPE MODIFICATIONS

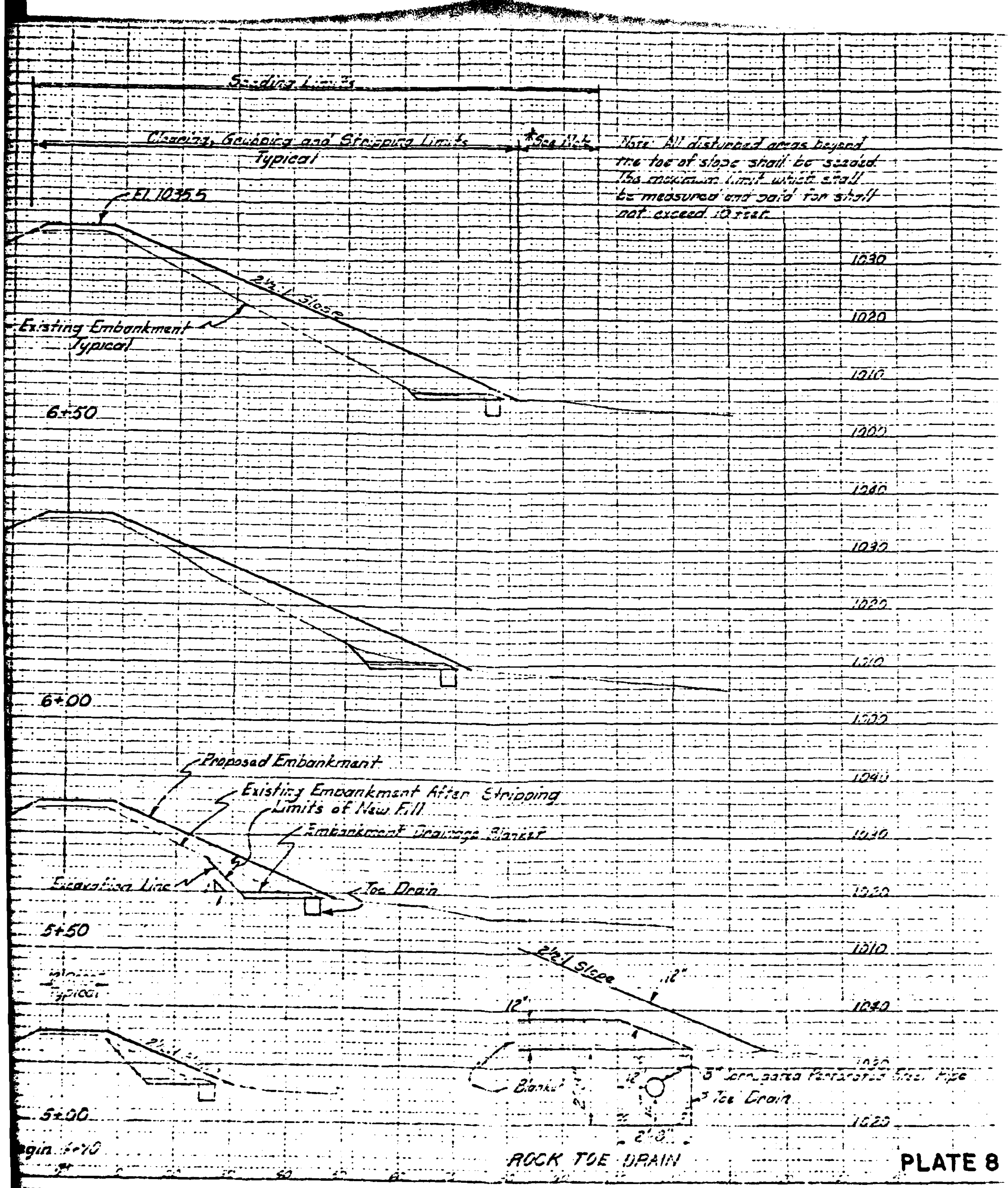


PLATE 8

X-SECTIONS STA. 5+00 TO 6+50

Note: Place Compacted Fill to Top of Lower Scarp Trench. Cut for and Place Blanket Material in Trench. Continue Compacted Fill to Top of Drain El. 1008 and Repeat Process.

PREPARED BY: BURGESS & NIPLE, LIMITED
PREPARED FOR: WESTERN PENNSYLVANIA WATER CO.
WASHINGTON DISTRICT
NAME OF DAM: CANONSBURG DAM NO. 2

TITLE: CROSS-SECTIONS STA. 7+00 TO 7+30
SHOWING PROPOSED SLOPE MODIFICATIONS

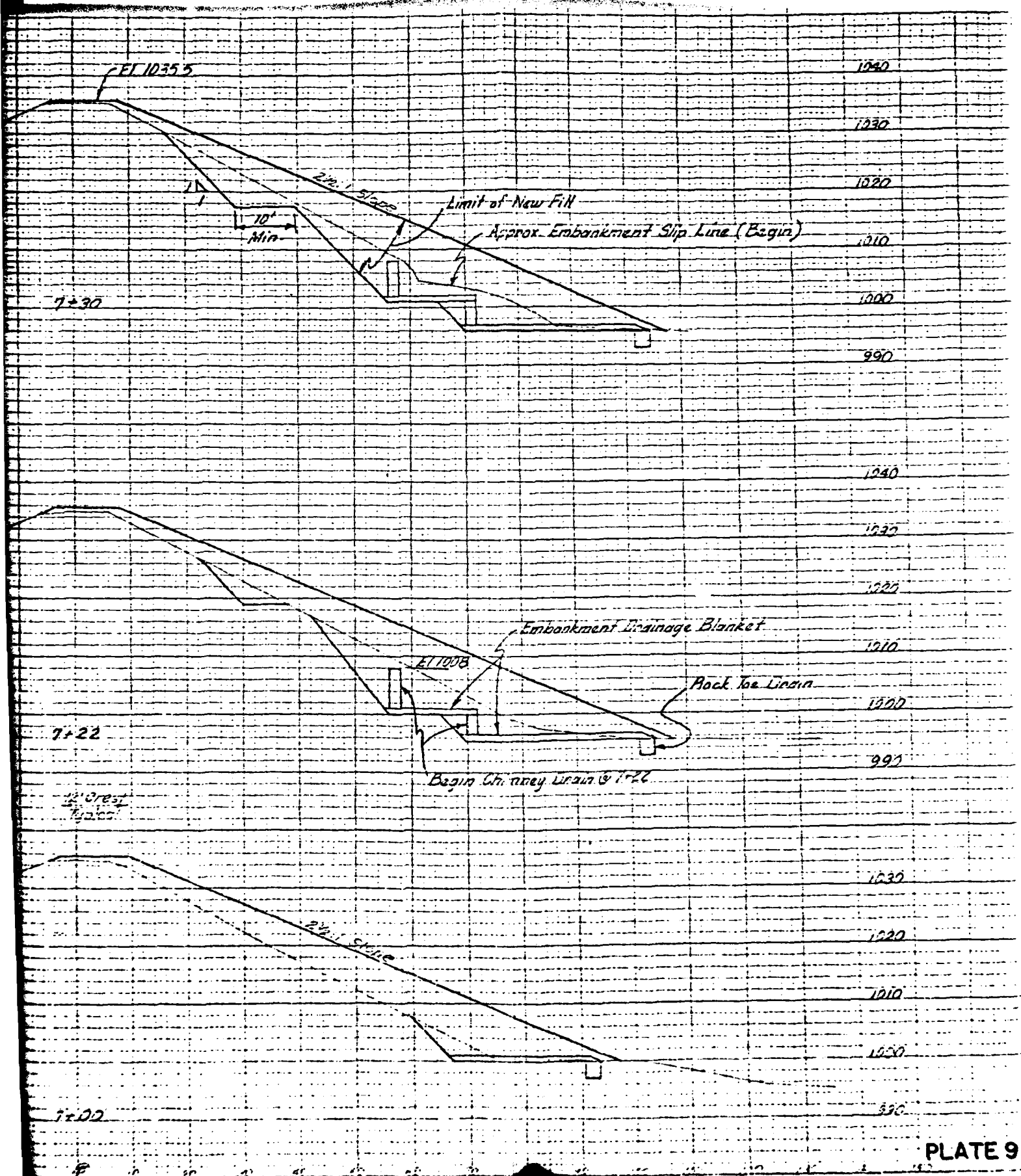
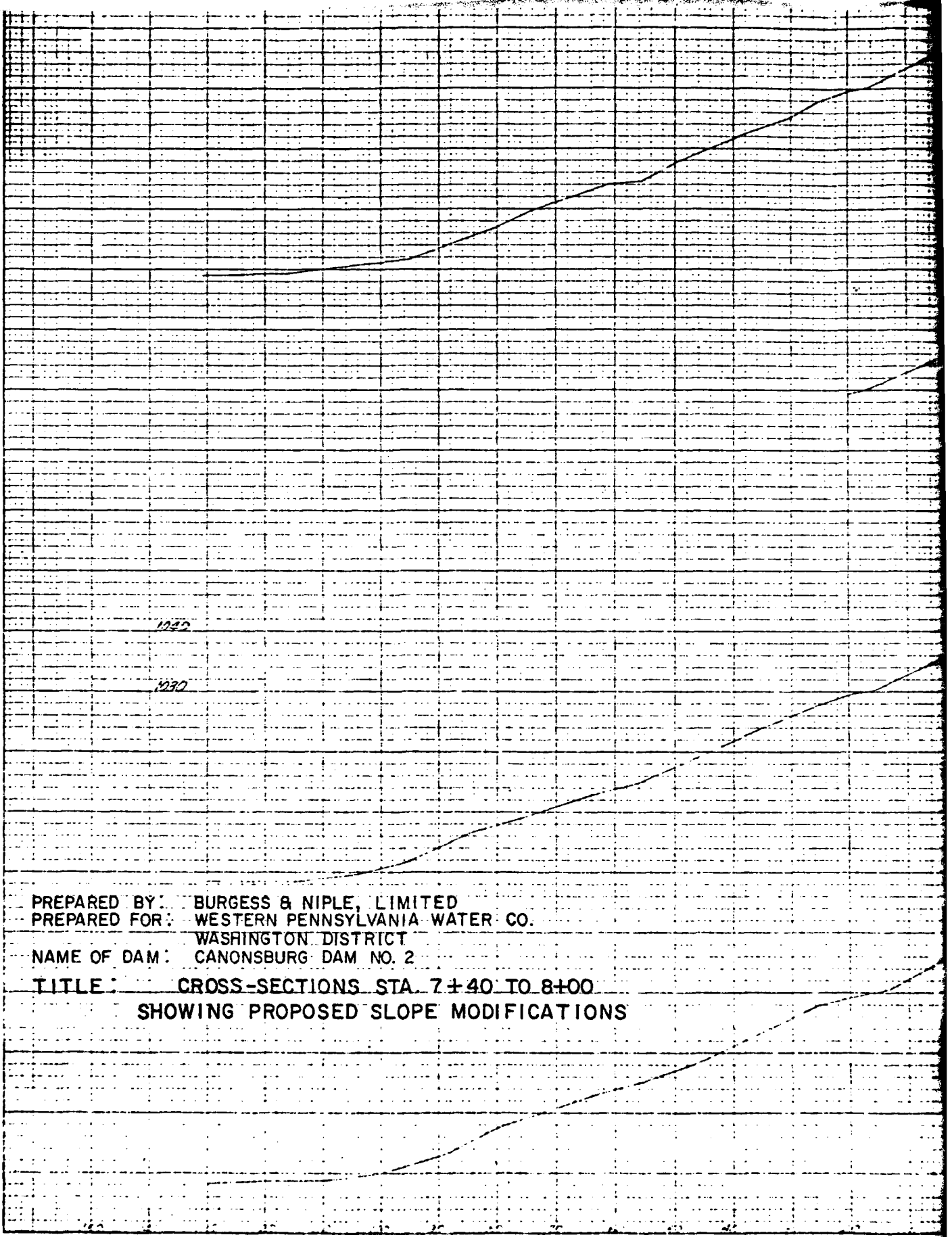


PLATE 9

X-SECTIONS STA. 7+00 TO 7+30 3/4



PREPARED BY: BURGESS & NIPLE, LIMITED
PREPARED FOR: WESTERN PENNSYLVANIA WATER CO.
WASHINGTON DISTRICT
NAME OF DAM: CANONSBURG DAM NO. 2

TITLE: CROSS-SECTIONS STA. 7+40 TO 8+00
SHOWING PROPOSED SLOPE MODIFICATIONS

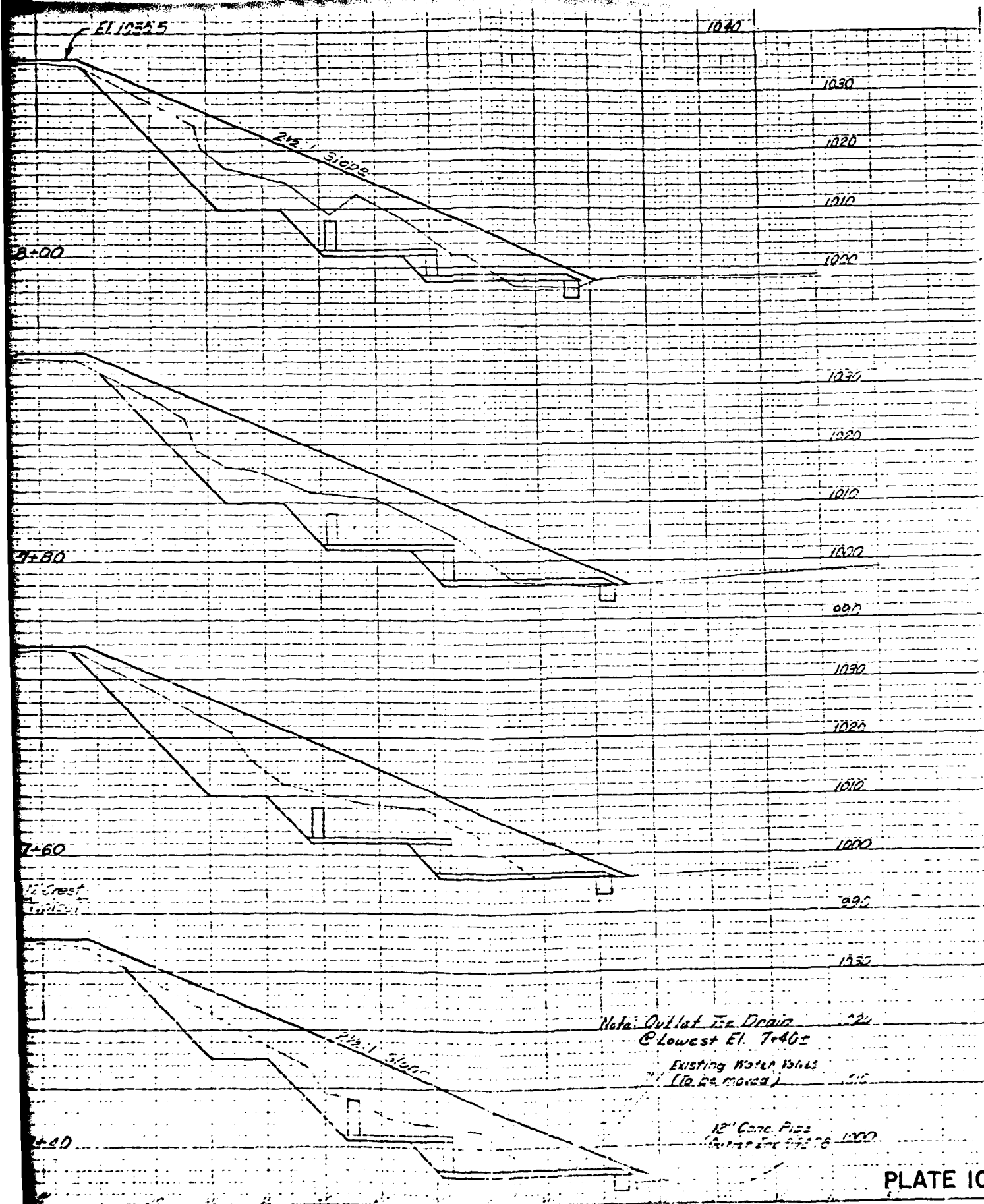
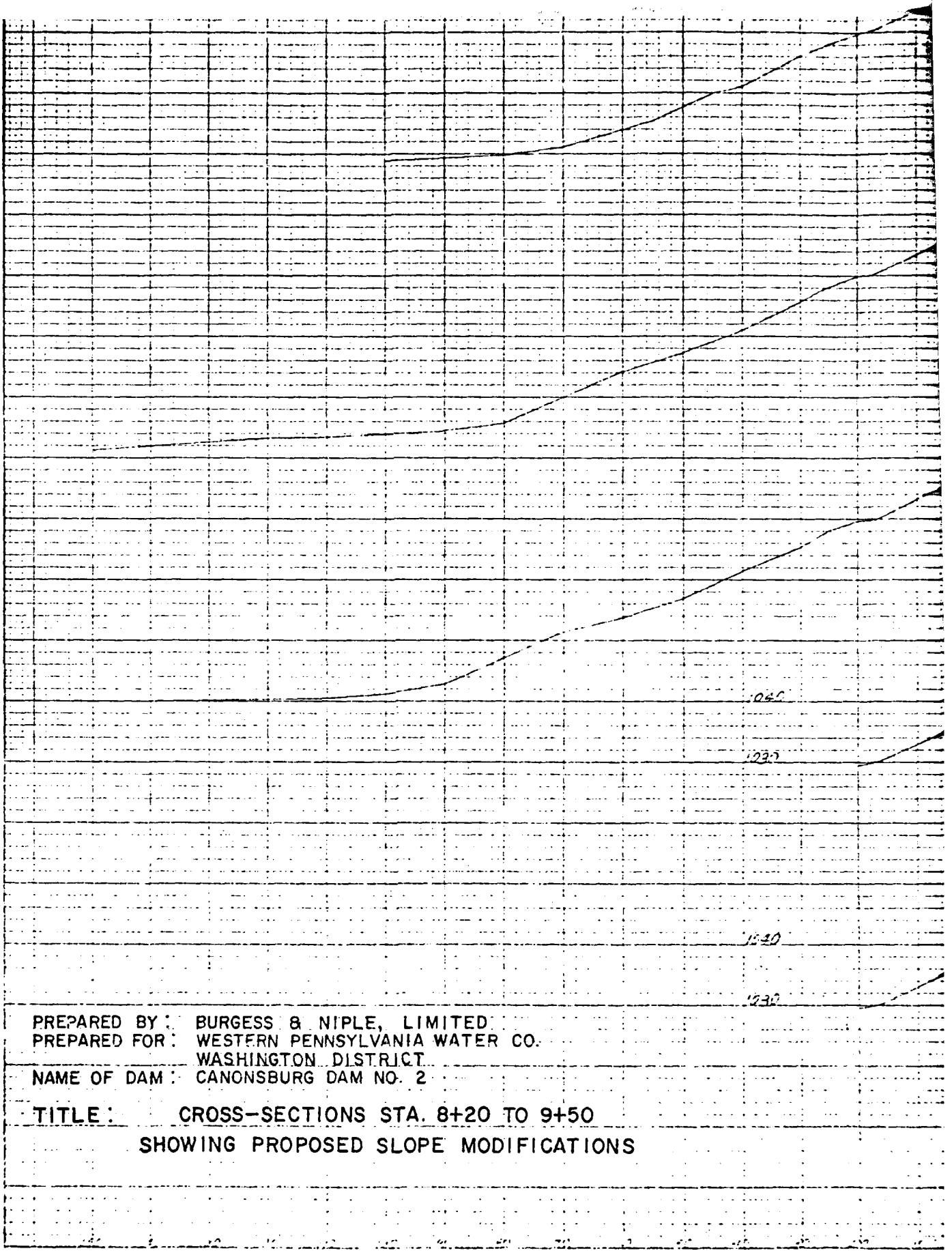


PLATE 10

X-SECTIONS STA. 7+40 TO 8+00



PREPARED BY: BURGESS & NIPLE, LIMITED
PREPARED FOR: WESTERN PENNSYLVANIA WATER CO.
WASHINGTON DISTRICT
NAME OF DAM: CANONSBURG DAM NO. 2

TITLE: CROSS-SECTIONS STA. 8+20 TO 9+50
SHOWING PROPOSED SLOPE MODIFICATIONS

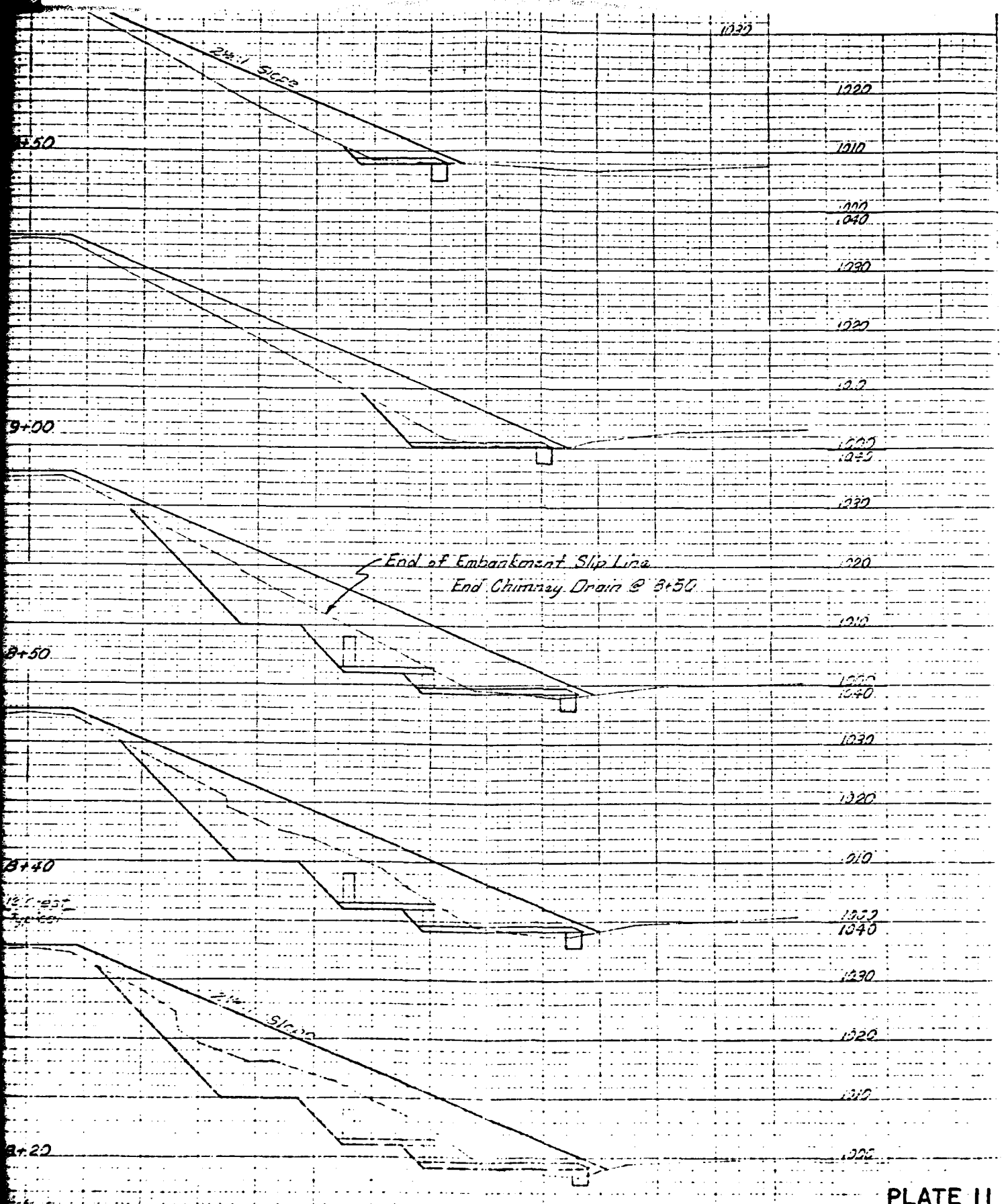


PLATE 11

X-SECTIONS STA. 8+20 TO 9+50

2

PREPARED BY: BURGESS & NIPLE, LIMITED
PREPARED FOR: WESTERN PENNSYLVANIA WATER CO.
WASHINGTON DISTRICT
NAME OF DAM: CANONSBURG DAM NO. 2

TITLE: CROSS-SECTIONS STA. 10+00 TO 11+50
SHOWING PROPOSED SLOPE MODIFICATIONS

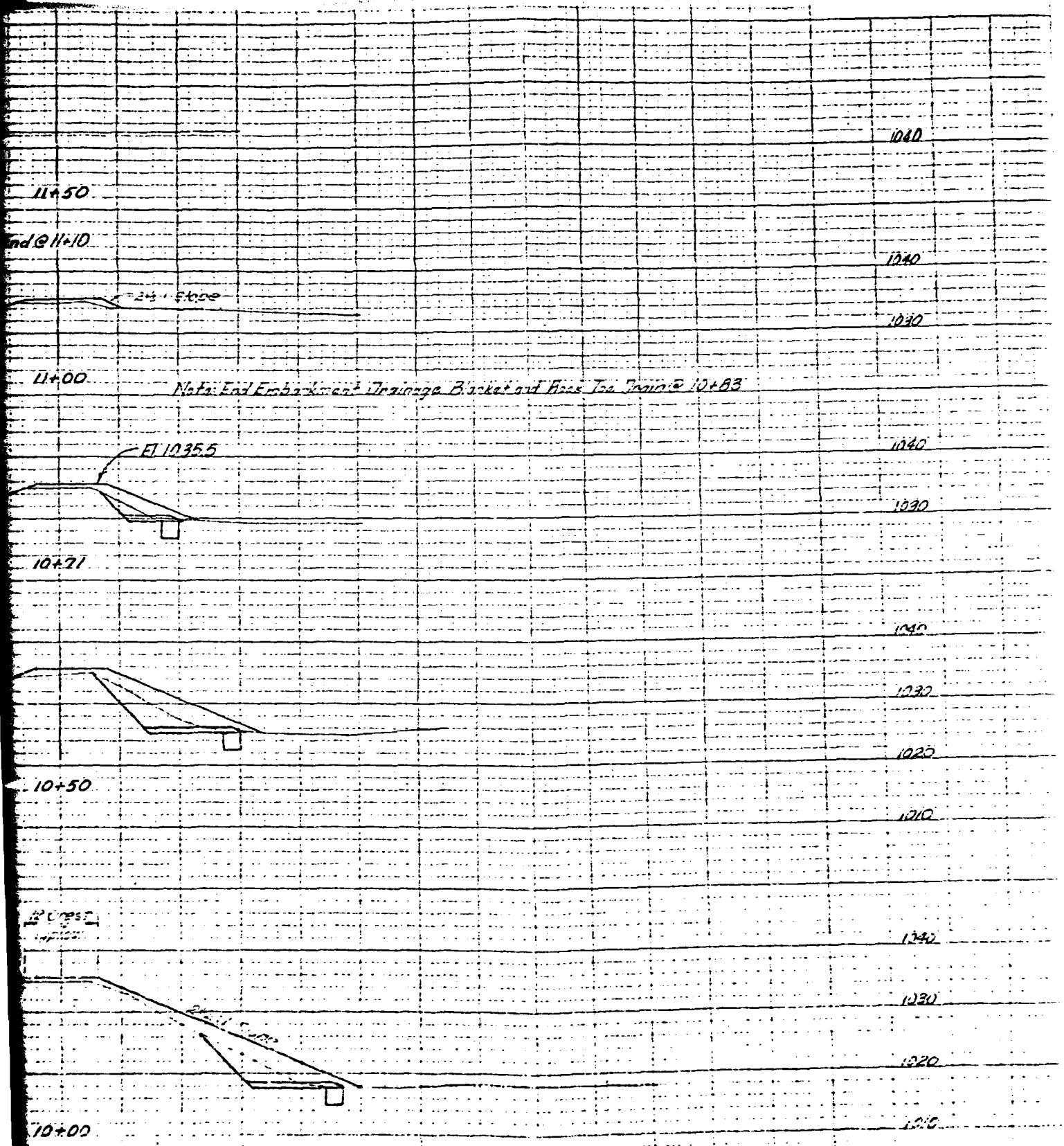


PLATE 12

X-SECTIONS STA 10+00 TO 11+50

2

APPENDIX F

REGIONAL GEOLOGY

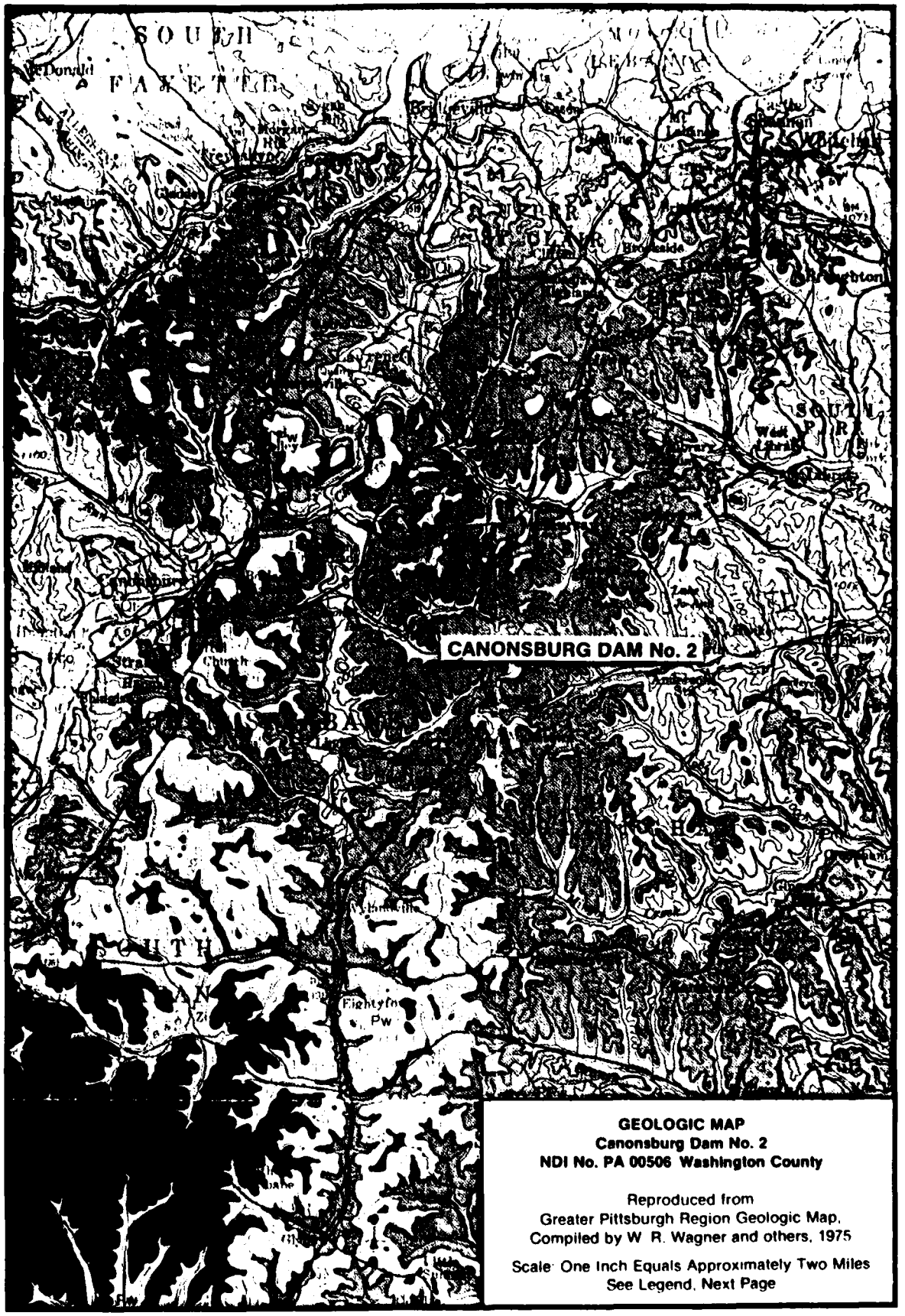
CANONSBURG DAM No. 2
(JOHNSONS RUN DAM)
NDI No. PA 00506, PennDER No. 63-41

REGIONAL GEOLOGY

Canonsburg Dam No. 2 is located on Johnsons Run in an unglaciated area of the Appalachian Plateaus Physiographic Province. Bedrock units below the dam are members of the Monongahela Group, Pennsylvanian System. Bedrock in this formation is typically cyclic sequences of shale, limestone, sandstone, and coal.

Original design borings and borings recently performed (1979) to investigate the embankment and slide indicate the original soil is approximately 9 feet thick and is silty clay (CL) with some soil designated as sandy clayey silt (ML). The bedrock below the soil in decreasing elevation is limestone, sandstone, siltstone, and limestone. This is probably the Uniontown limestone member.

Coal of a currently mineable character located below the dam is the Pittsburgh coal at Elevation 800 feet (approximately 200 feet deep). The Redstone coal is mined further east from the dam site (near Hackett) but has not been identified as being present below the dam. The Upper Freeport coal is located below the Pittsburgh coal but generally has not been mined in this area.



GEOLOGIC MAP
Canonsburg Dam No. 2
NDI No. PA 00506 Washington County

Reproduced from
Greater Pittsburgh Region Geologic Map,
Compiled by W. R. Wagner and others, 1975

Scale: One Inch Equals Approximately Two Miles
See Legend, Next Page

GEOLOGY MAP LEGEND

GROUP	FORMATION		DESCRIPTION
	Alluvium	Qt	Sand, gravel, clay.
	Terrace deposits		Sand, clay, gravel on terraces above present rivers; includes Carmichaels Formation.
DUNKARD	Greene		Cyclic sequences of sandstone, shale, red beds, thin limestones and coals.
DUNKARD	Washington	Pw	Cyclic sequences of sandstone, shale, limestone, and coal; contains Washington coal bed at base.
DUNKARD	Waynesburg		Cyclic sequences of sandstone, shale, limestone and coal; contains Waynesburg coal bed at base.
MONONGAHELA		Pm	Cyclic sequences of shale, limestone, sandstone and coal; contains Pittsburgh coal bed at base.
P: CONEMAUGH	Casselman	Pcc	Cyclic sequence of sandstone, shale, red beds and thin limestone and coal.
P: CONEMAUGH	Ames		
P: CONEMAUGH	Glenshaw	Pcg	Cyclic sequences of sandstone, shale, red beds and thin limestone and coal; several fossiliferous limestone; Ames limestone bed at top.
ALLEGHENY	Vanport	Pa	Cyclic sequences of shale, sandstone, limestone, and coal; contains Brookville coal at base and Upper Freeport coal at top; within group are the commercial Vanport limestone and Kittanning and Clarion coals.
ALLEGHENY	Vanport	Pa	
POTTSVILLE			Sandstone and shale; contains some conglomerate and locally mineable coal.
Mauch Chunk			Red and green shale with some sandstone; contains Wymps Gap and Loyalhanna limestones.
Pocono			Sandstone and shale with Burgoon sandstone at top.